Appeal In The Matter Of Department Permits L-24572-24-C-N, L-24572-TF-D-N, L-24572-IW-E-N, L-24572-24-F-N and L 24572-TF-G-N // Approval for Oakfield Wind Project Expansion

- Licensee Exhibit H

    Evergreen Application, Section 7, Appendices 7-4 (Fall 2007 Bat Migration Survey Report) and 7-5 (Spring and Summer 2008 Bird and Bat Migration Survey Report)

Appendix 7-4
Fall 2007 Bat Migration Survey Report for the Oakfield Wind Project, Oakfield, Maine

Fall 2007 Bat Migration Survey Report

Acoustic Bat Surveys for the Oakfield Wind Project In Oakfield, Maine

Prepared for

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July 2008

FINAL

Executive Summary

During fall 2007, Stantec Consulting (Stantec), formerly Woodlot Alternatives, Inc. (Woodlot)[1], conducted field surveys of bat migration activity at the Oakfield wind project area in Oakfield, Maine. The surveys are part of the planning process by UPC Wind Management, LLC (UPC) for a proposed wind project (Project). These surveys represented the first season of investigation undertaken at this site.

The results of the field surveys provide useful information about site-specific migration activity and patterns in the vicinity of the Project area, including species composition and timing.

Bat Survey

The 2007 field survey included documentation of fall bat activity through passive surveys with four acoustic detectors deployed in trees, resulting in 265 detector-nights of recordings from August 2 thru November 1. Four detectors were initially deployed in trees in the Project area; however, two detectors were moved to the meteorological tower after it was erected in late September. A total of 1,082 bat call sequences were recorded during the fall sampling period. The mean detection rate of all detectors was 4.1 detections per detector-night. The detection rate was generally similar to results of other fall surveys deployed in trees in Maine and the region. Habitat, landscape, location, and survey effort may account for the observed differences.

Bat calls were identified to the lowest possible taxonomic level. These were then grouped into four guilds based on similarity in call characteristics between some species and the inability of detectors to adequately and reliably distinguish between other species. The majority of calls (51%) were identified as *Myotis*, followed by unknown calls that could not be identified to guild (46%). Fewer than one percent of calls were identified as big brown guild or as eastern pipistrelle/red bat guild. This trend in species composition is similar to that of other studies in the region.

[1] All field work and any reporting and permitting activities performed prior to October 1, 2007, were conducted as Woodlot Alternatives, Inc. and will be herein referenced as work done by Woodlot. On October 1, 2007, Woodlot Alternatives, Inc. was acquired by Stantec Consulting Services, Inc. Work conducted on or after October 1, 2007, is herein referenced as work done by Stantec.

Table of Contents

PN195600152/107217

1.0 Introduction

This report has been prepared to provide a summary of the results of the fall acoustic detector surveys conducted in the Oakfield project area, including activity patterns and species composition.

Following is a brief description of the project; a review of the methods used to conduct scientific surveys and the results of those surveys; a discussion of those results; and the conclusions reached based on those results.

1.1 PROJECT CONTEXT

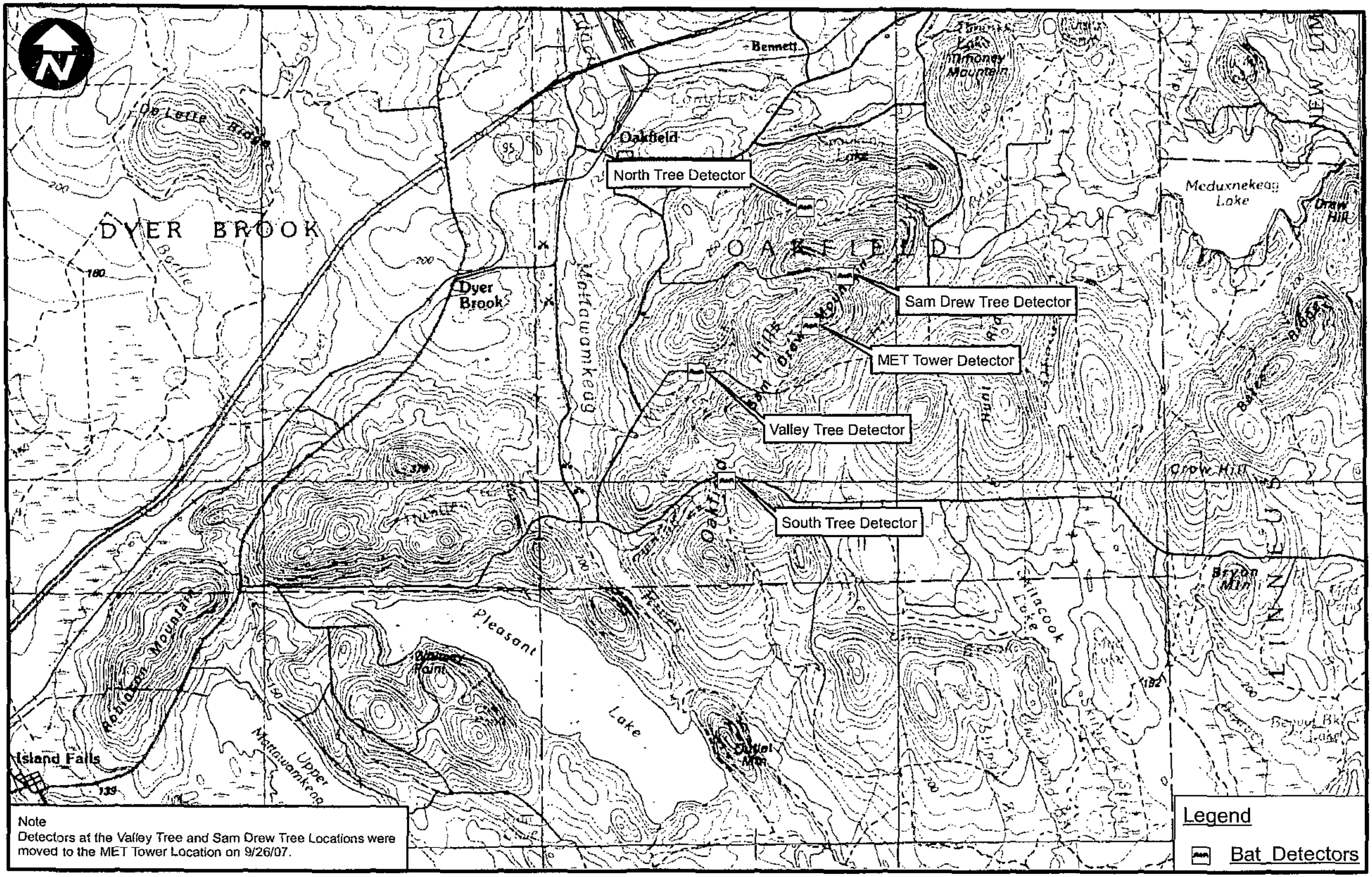
UPC Wind Management, LLC (UPC) has proposed construction of a wind project located in Oakfield in Aroostook County, Maine (Figure 1-1). The project is still in the preliminary stages of design, but is expected to consist of 20 to 30 turbines in the Oakfield Hills and an electrical transmission line that will connect to an existing electrical power line that is located near the town of Linneus, Maine (Project).

In advance of permitting activities for this project, UPC contracted Stantec Consulting, (Stantec) formerly Woodlot Alternatives, Inc.[2], to conduct acoustic detector surveys to determine the presence and, when possible, species composition of bats in the Project area during the fall migration period. The surveys will provide data to help assess the potential risk to bats from the proposed Project. The scope of the bat surveys was based on a combination of standard methods that are developing within the wind power industry for pre-construction surveys and is consistent with several other studies conducted recently in Maine and throughout the Northeast region of the United States.

1.2 PROJECT AREA DESCRIPTION

The Project area is situated in the town of Oakfield, Aroostook County, Maine. In general, the majority of the landscape is a transition zone with two dominant land uses characteristic of unorganized townships in northeastern Maine - agriculture and commercial timber management. Timber management has traditionally occurred along most of the two ridges and active agriculture occurs at lower elevations where favorable soils occur, and several seasonal camps are located intermittently near existing gravel roads (Figure 1-1).

[2] On October 1, 2007, Woodlot Alternatives, Inc. was formally acquired by Stantec Consulting Services, Inc.



Prepared By:

WOODLOT

Stantec

107217-F101-Bat.mxd

Sheet Title:

Bat Detector Location Map

Project:

Oakfield Wind Project
Oakfield, Maine

0 7,000 Feet

Date:	Jan. 9, 2008
Scale:	1" = 7000'
Proj. No.:	195600152
Figure.	1.1

The Project area is located within the Aroostook Hills and Lowlands Ecoregion of Maine, one of the eight regions identified in Maine's Comprehensive Wildlife Conservation Strategy (MDIFW 2005). Various areas of theses state ecoregions were previously delineated and characterized by McMahon (1990) based on areas demonstrating similar climate, soils, topography, and vegetation.

The Aroostook Hills and Lowlands Ecoregion is an area of approximately 2.5 million acres that is characterized by its calcareous soils and predominance of bedrock in the hills, while deep loams provide the basis for a large agricultural land use in the lowlands. The region also serves as the transition from temperate northern forests to the boreal spruce-fir forests that occur to the north and throughout Canada. Approximately half of the area is owned by commercial timber management companies in unorganized townships. Overall the region remains sparsely populated compared to areas in central and southern Maine.

A variation of the naturally occurring Beech – Birch – Maple Forest is the dominant forest community in the Project area. This type of Northern Hardwood Forest occurs in rich soils, under a closed canopy (in natural conditions), and includes a combination of American beech (*Fagus grandifolia*), yellow birch (*Betula alleghaniensis*), and sugar maple (*Acer saccharum*) as dominant canopy species. The percent coverage of the dominant canopy species varies along the ridgelines, particularly as a result of the timber management activities treatments. A variation of the Spruce – Northern Hardwoods Forest community also occurs in the project area. Dominant canopy trees include red spruce (*Picea rubens*), yellow birch, and other hardwood species including beech and sugar maple. Examples of this community variation occur along the northern and southern ridgeline of Oakfield Hills. Hunt Ridge may include a similar community variation or include other spruce-fir communities.

2.0 Acoustic Bat Survey

A total of eight species of bats are recognized to occur in Maine, based upon their normal geographical range. These are the little brown bat (*Myotis lucifugus*), northern long-eared bat (*M. septentrionalis*), eastern small-footed bat (*M. leibii*), silver-haired bat (*Lasionycteris noctivagans*), eastern pipistrelle (*Pipistrellus subflavus*), big brown bat (*Eptesicus fuscus*), eastern red bat (*Lasiurus borealis*), and hoary bat (*L. cinereus*) (Whitaker and Hamilton 1998). All eight species are listed as species of Special Concern in Maine due to a lack of information on population size and trends. All but the eastern small-footed bat are believed to occur in most of the state; the eastern small-footed bat is believed to be rare, but population size and trends are not well known for this species.

2.1 INTRODUCTION

Stantec conducted acoustic monitoring surveys with Anabat detectors during fall 2007. Acoustic bat detectors allow for long-term monitoring of activity patterns of bats in a variety of habitats, including the air space approaching the rotor-swept zone of modern wind turbines. The acoustic bat survey at Oakfield was designed to document bat activity patterns near the rotor zone of the proposed turbines, at an intermediate height, and near the ground. Because meteorological towers were not installed until late September, detectors were deployed in trees and then moved to the tower during the course of the seasonal survey; results for tree and tower detectors are reported separately. Acoustic surveys were also intended to document bat activity patterns in relation to local temperature and humidity levels.

2.2 METHODS

2.2.1 Field Surveys

Anabat II detectors (Titley Electronics Pty Ltd.) were used for the duration of the fall 2007 acoustic bat survey. Each Anabat detector was coupled with CF Storage ZCAIM (Titley Electronics Pty Ltd.), which programmed the on/off times and stored data on removable 1 GB compact flash cards. Anabat detectors are frequency division detectors, dividing the frequency of ultrasonic calls made by bats by a factor of 16 so that they are audible to humans, and recording the bat calls for subsequent analysis. Anabat detectors were selected based upon their widespread use for this type of survey, their ability to be deployed for long periods of time, and their ability to detect a broad frequency range, which allows detection of all species of bats that could occur in the Project area.

Four detectors were deployed within the project area between early August and November 1, and programmed to record data continuously between 7:00 pm and 7:00 am each night. Detectors were powered by 12-volt batteries charged by solar panels. Because met towers were not deployed until late September, detectors were initially deployed in trees at heights of 3 meters (m; 10 feet [']) to 6 m (20'), and then two detectors were moved to the tower at heights of 10 m (32') to 15 m (65') on September 25 (Figure 1-1).

Each solar-powered Anabat system was deployed in a waterproof housing enabling the detector to record while unattended for the duration of the survey. The housing suspends the Anabat microphone downward to give maximum protection from precipitation. To compensate for the downward position, a reflector shield of smooth plastic is placed at a 45-degree angle directly below the microphone. The angled reflector allows the microphone to record the airspace horizontally surrounding the detector and is only slightly less sensitive than an unmodified Anabat unit.

Maintenance visits were conducted approximately every one to two weeks to check on the condition of the detectors and download data to a computer for analysis. The sensitivity of each Anabat system was set at between six and seven to maximize sensitivity while limiting ambient background noise and interference. The sensitivity of individual detectors was tested using an ultrasonic Bat Chirp (Reno, NV) to ensure that the detectors would be able to detect bats up to a distance of at least 10 m (33').

2.2.2 Data Analysis

Potential call files were extracted from data files using CFCread© software. The default settings for CFCread© were used during this file extraction process, as these settings are recommended for the calls that are characteristic of northeastern bats. This software screens all data recorded by the bat detector and extracts call files using a filter. Using the default settings for this initial screen also ensures comparability between data sets. Settings used by the filter include a max TBC (time between calls) of 5 seconds, a minimum line length of 5 milliseconds, and a smoothing factor of 50. The smoothing factor refers to whether or not adjacent pixels can be connected with a smooth line. The higher the smoothing factor, the less restrictive the filter is and the more noise files and poor quality call sequences are retained within the data set. A call is a single pulse of sound produced by a bat. A call sequence is a combination of two or more pulses recorded in a call file. Understanding these parameters is important in understanding when species identification are termed "unknown".

Following extraction of call files, each file was visually inspected to ensure that files created by static or some other form of interference that were still within the frequency range of northeastern bats were not included in the data set. Call sequences were identified based on visual comparison of call sequences to reference calls provided by Chris Corben, developer of the Anabat system, and nationally-recognized bat expert Lynn Robbins. Bat calls typically include a series of pulses characteristic of normal flight or prey location ("search phase" calls) and capture periods (feeding "buzzes") and visually look very different than static, which typically forms a diffuse band of dots at either a constant frequency or widely varying frequency, caused by wind, vibration, or other interference. Using these characteristics, bat call files are easily distinguished from non-bat files.

Bat call sequences were individually marked and categorized by species group, or "guild" based on visual comparison to reference calls. Qualitative visual comparison of recorded call sequences of sufficient length to reference libraries of bat calls allows for relatively accurate identification of bat species (O'Farrell *et al.* 1999, O'Farrell and Gannon 1999). A call sequence was considered of suitable quality and duration if the individual call pulses were "clean" (i.e., consisting of sharp, distinct lines) and at least five pulses were included within the sequence. Call sequences were classified to species whenever possible, using the reference calls described above. However, due to similarity of call signatures between several species, all classified calls have been categorized into four guilds for presentation in this report. This classification scheme follows that of Gannon *et al.* (2003) and is as follows:

- **Unknown (UNKN)** – all call sequences with too few pulses (less than five) or of poor quality (such as indistinct pulse characteristics or background static). These calls were further identified as either "high frequency unknown" (HFUN) for calls above 35 kHz or "low frequency unknown" (LFUN) for calls below 35 kHz;

- **Myotid (MYSP)** – All bats of the genus *Myotis*. While there are some general characteristics believed to be distinctive for several of the species in this genus, these characteristics do not occur consistently enough for any one species to be relied upon at all times when using Anabat recordings;

- **Red bat/pipistrelle (RBEP)** – Eastern red bats and eastern pipistrelles. Like many of the other northeastern bats, these two species can produce calls distinctive only to each species. However, significant overlap in the call pulse shape, frequency range, and slope can also occur. Evening bats would also be included in this guild, and;
- **Big brown/silver-haired/hoary bat (BBSHHB)** – This guild will be referred to as the big brown guild. These species' call signatures commonly overlap and have therefore been included as one guild in this report.

This guild grouping represents the most conservative approach to bat call identification (Hayes 2000). Since some species do sometimes produce calls unique only to that species, all calls were identified to the lowest possible taxonomic level before being grouped into the listed guilds. Tables and figures in the body of this report will reflect those guilds. However, since species-specific identification did occur in some cases, each guild will also be briefly discussed with respect to potential species composition of recorded call sequences.

Once all of the call files were identified and categorized in appropriate guilds, nightly tallies of detected calls were compiled. Mean detection rates (number of calls/detector-night) for the entire sampling period were calculated for each detector and for all detectors combined. It is important to note that detection rates indicate only the number of calls detected and do not necessarily reflect the number of individual bats in an area. For example, a single individual can produce one or many call files recorded by the bat detector, but the bat detector cannot differentiate between individuals of the same species producing those calls. Consequently, detections recorded by the bat detector system likely over-represent the actual number of animals that produced the recorded calls.

2.2.3 Weather Data

Temperature and humidity data were recorded from August 20 to October 31 at 10-minute intervals by data loggers (HOBO Pro v2 U23-001, Onset Computer Corporation) placed on at least one of the bat detector systems. The mean, maximum, and minimum temperatures and humidity were calculated for each night.

2.3 RESULTS

2.3.1 Detector Call Analysis

Detectors were deployed on August 2 and continued to record data through November 1, for a total survey period of up to 79 nights per detector. The range of dates that each detector was deployed is summarized in Table 2-1. Occasional data gaps occurred when certain detectors powered down during the survey period. To account for these periods, the number of detector-nights is reported for each detector. Combined, the four detectors deployed at Oakfield sampled a total of 265 detector-nights during the fall survey period.

A total of 1,082 bat call sequences were recorded during the sampling period (Table 2-1). The number of call sequences recorded by each detector ranged from 0 at the Met Low detector to 456 at the Valley Tree detector. The overall mean detection rate for all four detectors deployed in trees was 4.1 calls/detector-night. No calls were recorded by the detectors deployed in the tower after September 26. Detection rates at each of the tree detectors ranged from 1.8 calls/detector-night at the North Tree detector to 10.6 calls/detector-night at the Valley Tree detector. The maximum number of call sequences recorded in one night ranged from 8 at the North Tree detector to 58 at the Valley Tree detector.

Table 2-1. Summary of bat detector field survey effort and results

Location	Dates	# Detector-Nights*	# Recorded sequences	Detection Rate **	Maximum # calls recorded ***
South Tree	8/2 - 9/11, 9/26 - 11/1	78	346	4.4	28
North Tree	8/2 - 8/18, 8/22 - 9/25	52	93	1.8	8
Sam Drew Tree	8/2 - 9/25	55	187	3.4	29
Valley Tree	8/2 - 9/25	43	456	10.6	58
Met High	9/26 - 11/1	37	0	0.0	0
Met Low	9/26 - 11/1	0	0	0.0	0
Overall Results		***265***	***1082***	***4.1***	--

* Detector-night is a sampling unit during which a single detector is deployed overnight. On nights when two detectors are deployed, the sampling effort equals two detector-nights, etc.

** Number of bat passes recorded per detector-night.

*** Maximum number of bat passes recorded from any **single** detector for a 12-hour sampling period.

Appendix A provides a series of tables with more specific information on the nightly timing, number, and species composition of recorded bat call sequences. Specifically, Appendix A Tables 1 through 6 provide information on the number of call sequences, by guild and suspected species, recorded at each detector and the weather conditions for that night. Upon request, Stantec can provide a spreadsheet identifying the the Analook file name for all 1,082 recorded call sequences, the night during which the call sequence was recorded, the timing of the recording, and the suspected identity of the species recorded.

Overall, peak numbers of call sequences were recorded at Oakfield in early August (Figure 2-1). Individually, all four tree detectors recorded peak levels of calls during this same time span, but two detectors had additional peaks: the South Tree detector had a smaller peak in late August, and the Valley Tree detector had a smaller peak in early and late September. Since neither of these two detectors ever recorded more than 42 calls in one night during these peaks, the effect of these two additional peaks is minimal when all activity is taken into account. Overall, all four detectors had a nightly peak in activity between 10:00 and 11:00 pm (Figure 2-2). These peaks in overall activity were consistent at an individual detector level.

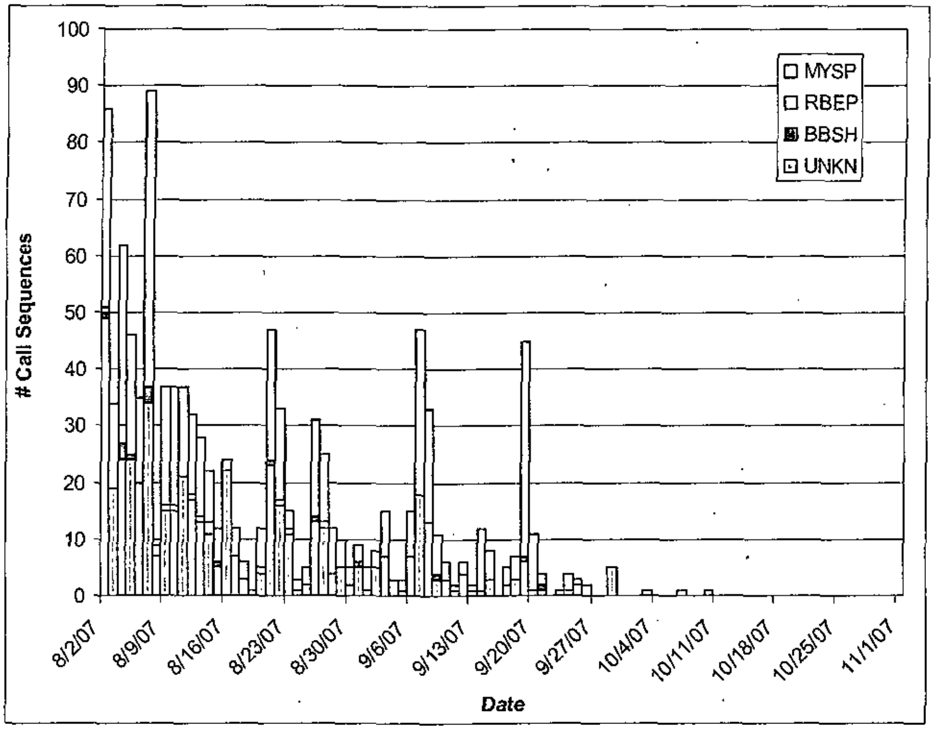


Figure 2-1. *Total nightly bat call sequence detections for all detectors deployed during fall 2007*

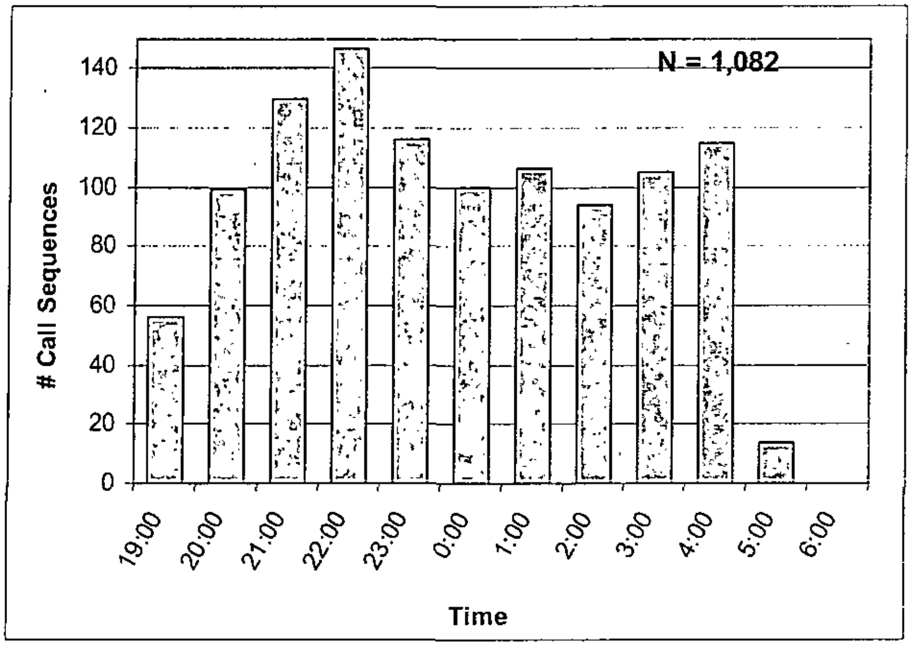


Figure 2-2. Nightly timing of recorded bat activity for all detectors deployed during fall 2007

Some of the recorded call sequences (46%) were labeled as unknown due to very short call sequences (less than seven pulses) or poor call signature formation (probably due to a bat flying at the edge of the detection zone of the detector or flying away from the microphone) (Table 2-2). Of all the calls that were identified to species or guild, those of the MYSP guild were the most common (51% of all call sequences), followed by the species within the BBSHHB guild (1% of all call sequences) and species within the red bat/eastern pipistrelle guild (1% of all call sequences).

Table 2-2. Summary of the composition of recorded bat call sequences.

Detector	Guild				Total
	Big brown guild	Red bat/ E. pipistrelle	Myotis	Unknown	
South Tree	4	6	226	110	346
North Tree	4	2	47	40	93
Sam Drew Tree	7	6	74	100	187
Valley Tree	0	0	209	247	456
Met High	0	0	0	0	0
Met Low	0	0	0	0	0
Total	***15***	***14***	***556***	***497***	***1,082***

Of the calls recorded at each detector identified to guild, those of the MYSP guild were the most common, and in most cases made up more than 40 percent of all calls. The RBEP guild made up the least number of calls recorded. At each detector, calls within the UNKN group made up approximately a third to half of all calls recorded.

2.3.2 Weather Data

Weather data is available for a portion of the survey period when dataloggers were deployed.

Mean nightly temperatures in the Project area from August 20 to October 31 varied between -1.1 and 21.8 degrees Celsius (°C; 34 and 71.2 degrees Fahrenheit [°F]) with an overall mean of 10.6 °C (51.1 °F). Total nightly bat call volumes were slightly positively correlated with mean nightly temperature (r=0.387) (Figure 2-3).

Mean nightly humidity in the Project area from August 20 to October 31 varied between 43.1 and 99.1 percent with an overall mean of 79 percent. Total nightly bat call volumes were negatively correlated with mean nightly humidity (r=-0.134) (Figure 2-4).

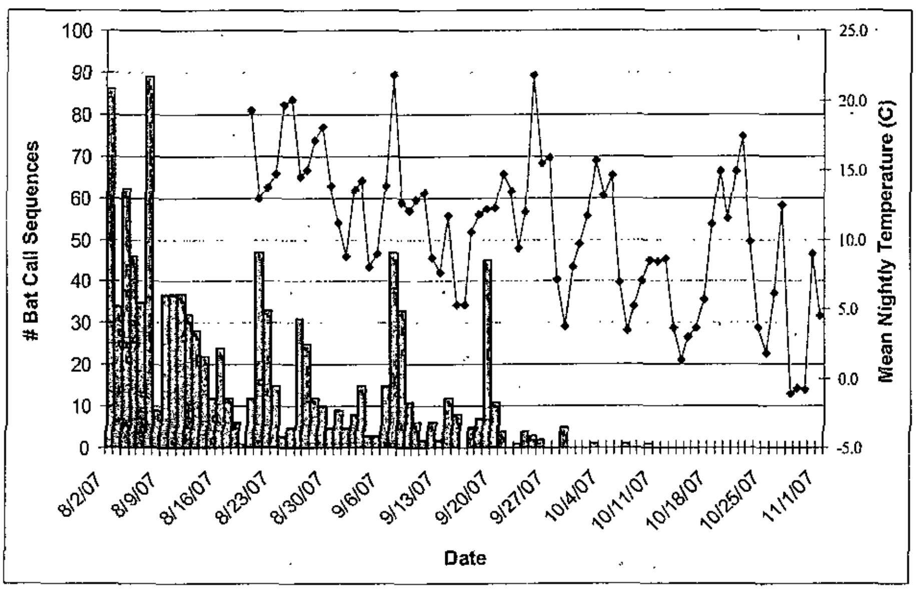


Figure 2-3. Relationship between mean nightly temperature and combined nightly bat call volume

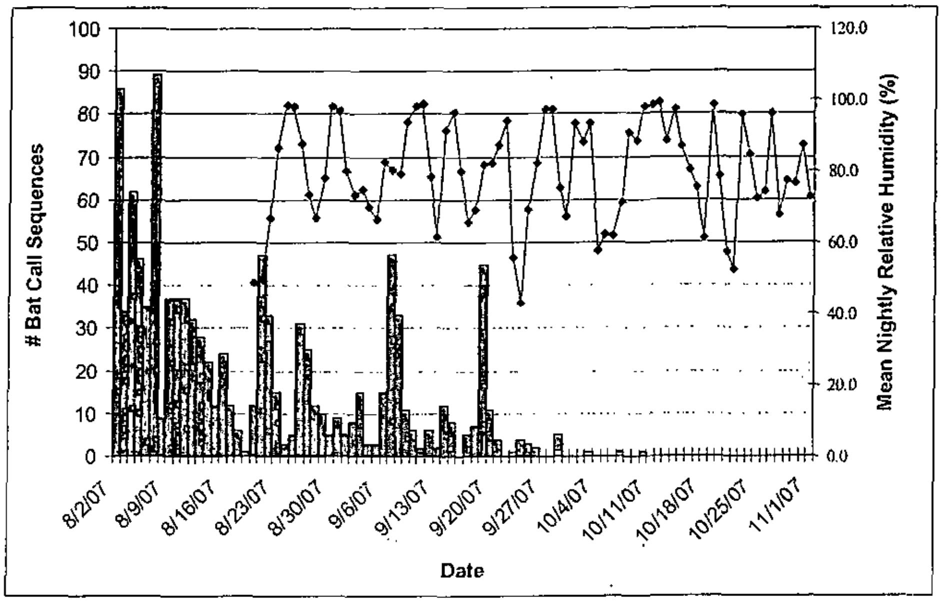


Figure 2-4. Relationship between mean nightly humidity and combined nightly bat call volume

2.4 DISCUSSION

Bat echolocation surveys in fall 2007 provide some insight into activity patterns, possible species composition, and timing of movements of bats in the Project area. Bat activity was variable among nights at all six acoustic sampling locations. Peak call sequence detections occurred during the first two weeks in August, with some individual detectors recording isolated peaks in late August and mid September. Overall nightly activity peaked at 10:00 pm, and seems to correlate with temperature. All detectors deployed in trees recorded bats belonging to all four guilds, except for the Valley Tree detector which did not record any sequences belonging to the BBSHHB or RBEP guild. Detectors deployed in the met tower from late September through October did not record any bat call sequences. The overall mean detection rate during the fall survey period was 4.1 calls/detector-night.

Bat calls were identified to guild within this report, although calls were provisionally categorized by species when possible during analysis. Certain species, such as the eastern red bat and hoary bat have easily identifiable calls, whereas other species, such as the big brown bat and silver-haired bat are difficult to distinguish acoustically. Similarly, certain members of the *Myotis* genus, such as the little brown bat, are far more common and have slightly more distinguishable calls than other species. The following paragraphs discuss each guild separately and address likely species composition of recorded bats within each guild.

The MYSP guild includes all three species of *Myotis* potentially occurring in the Project area, including the little brown bat, northern long-eared bat, and the eastern small-footed bat. Of these species, the little brown bat and northern long-eared bat are by far the most common, and have calls that tend to be slightly more distinguishable using the Anabat system. Calls in the MYSP guild were identified at all four detectors at Oakfield, 51 percent (n = 556) of all calls.

Species in the genus *Myotis* tend to fly lower and forage in more forested areas than other bat species in the area, so it is not surprising that all four detectors, which were suspended in trees, detected MYSP calls. Detectors placed close to the ground may record ground interference from other high frequency sound producers such as insects. In addition, detectors placed within forested areas often record interference produced as wind blows through vegetation. Given that distinguishing calls among species in the MYSP guild requires detecting very subtle differences in call structure, and that most of the MYSP calls at Oakfield were recorded in areas with varying degrees of interference, it is difficult to say which species within the guild have been recorded.

The BBSHHB guild includes the big brown bat, silver-haired bat, and hoary bat. Within this grouping, the hoary bat has easily distinguishable calls characterized by highly variable minimum frequencies often extending below 20 kHz, and a hooked profile similar to the eastern red bat. Calls of silver-haired bats and big brown bats are occasionally distinguishable, but often overlap in range and can be difficult to distinguish, especially when comparing short duration calls typical of those recorded during passive monitoring. Of the 15 calls classified as BBSHHB, 47 percent (n = 7) were recorded at the Sam Drew Tree detector, 27 percent at both the North Tree detector (n = 4) and at the South Tree detector (n = 4). None of the files recorded by the Valley Tree detector were classified as BBSHHB calls; however, low frequency unknown calls recorded by this detector could potentially belong to this group. Species within the BBSHHB guild generally fly higher than other species and forage in more open habitat, so it's not surprising that BBSHHB call sequences made up only 1 percent of all recorded files.

The RBEP guild includes the eastern pipistrelle and eastern red bat. Eastern red bats have relatively unique calls which span a wide range of frequency and have a characteristic hooked shape and variable minimum frequency. Eastern pipistrelles tend to have relatively uniform calls, with a constant minimum frequency and a sharply curved profile. Of the 14 calls classified as RBEP, 43 percent (n = 6) were recorded at the South Tree detector and at the Sam Drew Tree detector, and 14 percent (n = 2) were recorded at the North Tree detector. None of the files recorded by the Valley Tree detector were classified as RBEP calls; however, high frequency unknown calls recorded by this detector could potentially belong to this group. Overall, RBEP call sequences made up only 1 percent of all recorded files

Of the 1,082 total calls recorded at Oakfield, 497, or 46 percent, were classified as UNKN, due to their short duration or poor quality. However, these calls were identified as "high frequency" or "low frequency". For the purposes of this analysis, "high frequency" call fragments were defined as having a minimum frequency above 30 kHz, and "low frequency" calls were defined as having a minimum frequency below 30 kHz. Most (82%) of UNKN calls were identified as high frequency unknown (HFUN). These calls could potentially belong to either the MYSP or RBEP guilds. Given the large number of MYSP files recorded, most of the HFUN files are likely MYSP calls. This is reinforced by analysis notes indicating that most files identified as HFUN were thought to be short duration or low quality MYSP files.

Differences in detection rates between guilds at the various detectors deployed in the Project area may reflect varying vertical distribution and habitat preferences of bat species (Hayes

2000). Recent research (Arnett *et al.* 2006) found that small *Myotis* species were more frequently recorded at lower heights while larger species were typically recorded more often at higher heights. In forested habitat, both large and small species were recorded in greater numbers at a medium height of 22 m (72'), rather than at 1.5 m or 44 m (5 or 144'). At Oakfield, all detectors were in trees for most of the survey period and were placed at heights of approximately 3-6 m (9-19'). Species diversity was relatively consistent among all detectors.

Bat activity patterns during migration seem to be related to weather conditions based on mortality studies and acoustic surveys. Acoustic surveys have documented a decrease in bat activity rates as wind speeds increase and temperatures decrease, and bat activity has been shown to correlate negatively to low nightly mean temperatures (Hayes 1997, Reynolds 2006). Similarly, weather factors appeared related to bat collision mortality rates documented at two facilities in the southeastern United States, with mortality rates negatively correlated with both wind speed and relative humidity, and positively correlated to barometric pressure (Arnett 2005). These patterns suggest that bats are more likely to migrate on nights with low wind speeds (less than 4-6 m/s) and generally favorable weather (warm temperatures, low humidity, high barometric pressure). Similarly, bat activity at Oakfield seems to be positively correlated with mean nightly temperature and negatively correlated with mean nightly humidity.

Bat activity also appeared to vary by time of night, with peaks in activity occurring soon after dusk and before dawn. This bimodal nighttime distribution of bat activity documented at both met towers seems to be a consistent behavioral trend in a number of species (Hayes 1997). Anthony *et al.* (1981) documented that bats appear to leave roosting sites at dusk to forage for a given period, return to their roosts during the middle portion of the night, then forage again later in the evening, closer to dawn. However, patterns other than bimodal could be observed because considerable variation can occur within nights (Hayes, 1997). One peak of activity was observed at Oakfield, at 10:00 pm.

Results of acoustic surveys must be interpreted with caution. Considerable room for error exists in identification of bats based upon acoustic calls alone, especially if a site or regionally specific library of recorded reference calls is not available. Also, detection rates are not necessarily correlated with the actual numbers of bats in an area, because it is not possible to differentiate between individual bats (Hayes 2000).

2.5 CONCLUSIONS

Acoustic bat surveys documented bat activity in the project area between early August and late October. Species composition was fairly consistent between detectors, with *Myotids* comprising the majority of call sequences recorded by all the detectors identified to guild. Activity levels were positively correlated with temperature on a nightly basis. No sequences were recorded when the detectors were deployed in the tower during late September and through October.

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Appendix A

Bat survey results

Appendix A Table 1. Summary of acoustic bat data and weather during each survey night at the South Tree detector – Fall 2007

		BBSHHB				RBEP			MYSP	UNKN					
Night of	Operated Okay?	big brown bat	hoary bat	silver-haired bat	silver-haired/big brown	eastern pipistrelle	eastern red bat	pipistrelle/red bat	MYSP	high-frequency	low-frequency	unknown	Total	Relative Humidity (%)	Temperature (celsius)
8/2/07	y								10	4			14		
8/3/07	y								5	1			6		
8/4/07	y				1		1		20	4			26		
8/5/07	y								15	4	1		20		
8/6/07	y								7	1			8		
8/7/07	y				1				12	4			17		
8/8/07	y								1		2		3		
8/9/07	y								15	4			19		
8/10/07	y								11	4			15		
8/11/07	y								9	1			10		
8/12/07	y							1	4	1			6		
8/13/07	y						1		12	5			18		
8/14/07	y								6	3			9		
8/15/07	y				1				5	2			8		
8/16/07	y									2	1		3		
8/17/07	y								4	1			5		
8/18/07	y								3	1			4		
8/19/07	y									1			1		
8/20/07	y					1			6	1			8	48.8	19.3
8/21/07	y								18	10			28	50.0	13.0
8/22/07	y								5	5			10	66.9	13.8
8/23/07	y							1	2	3	5	1	12	86.7	14.7
8/24/07	y								2	1			3	98.6	19.7
8/25/07	y								2	1			3	98.3	20.1
8/26/07	y								11	7			18	87.9	14.5
8/27/07	y							1	8	6	1		16	73.6	15.0
8/28/07	y								7	3			10	67.0	17.1
8/29/07	y								5	2			7	78.0	18.1
8/30/07	y								2	1	1		4	98.2	13.8
8/31/07	y				1				2	1	1		5	97.1	11.2
9/1/07	y								4				4	80.0	8.8
9/2/07	y								3	3			6	73.4	13.5
9/3/07	y								6	1	2		9	74.9	14.2
9/4/07	y								1				1	69.9	8.0
9/5/07	y												0	66.5	8.9
9/6/07	y												0	82.8	13.8
9/7/07	y												0	80.2	21.8
9/8/07	y												0	79.3	12.7
9/9/07	y												0	94.0	12.1
9/10/07	y												0	98.1	12.8
9/11/07	y												0	99.0	13.4
9/12/07	n												n/o	78.5	8.7
9/13/07	n												n/o	61.6	7.6
9/14/07	n												n/o	91.4	11.7
9/15/07	n												n/o	96.4	5.3
9/16/07	n												n/o	80.0	5.3
9/17/07	n												n/o	65.6	10.5
9/18/07	n												n/o	69.1	11.8
9/19/07	n												n/o	82.0	12.2
9/20/07	n												n/o	82.2	12.2
9/21/07	n												n/o	87.4	14.7
9/22/07	n												n/o	94.4	13.5
9/23/07	n												n/o	55.8	9.3
9/24/07	n												n/o	43.1	12.0
9/25/07	n												n/o	69.4	21.8
9/26/07	y								2				2	82.2	15.5
9/27/07	y												0	97.2	15.9
9/28/07	y												0	97.3	7.1
9/29/07	y									2	1	2	5	75.5	3.7
9/30/07	y												0	67.3	8.0
10/1/07	y												0	93.6	9.6
10/2/07	y												0	87.9	11.7
10/3/07	y								1				1	93.6	15.7
10/4/07	y												0	57.7	13.2
10/5/07	y												0	62.2	14.6
10/6/07	y												0	61.9	7.0
10/7/07	y										1		1	71.0	3.5
10/8/07	y												0	90.7	5.2
10/9/07	y												0	88.6	7.0
10/10/07	y										1		1	97.9	8.5
10/11/07	y												0	98.5	8.4
10/12/07	y												0	99.1	8.6
10/13/07	y												0	88.3	3.6
10/14/07	y												0	97.2	1.3
10/15/07	y												0	85.8	2.9
10/16/07	y												0	80.4	3.6
10/17/07	y												0	75.3	5.7
10/18/07	y												0	61.1	11.1
10/19/07	y												0	98.4	14.9
10/20/07	y												0	78.3	11.5
10/21/07	y												0	57.2	14.9
10/22/07	y												0	52.2	17.4
10/23/07	y												0	95.9	9.8
10/24/07	y												0	84.6	3.7
10/25/07	y												0	72.2	1.8
10/26/07	y												0	74.2	6.2
10/27/07	y												0	96.1	12.4
10/28/07	y												0	67.6	-1.1
10/29/07	y												0	77.1	-0.7
10/30/07	y												0	76.4	-0.8
10/31/07	y												0	87.2	9.0
11/1/07	y													72.6	4.5
By Species		0	0	0	4	1	2	3	226	90	17	3	346		
By Guild		4				6			226	110					
		BBSHHB				RBEP			MYSP	UNKN			Total		

n/o - indicates that detector was not operating on that night

Appendix A Table 2. Summary of acoustic bat data and weather during each survey night at the North Tree detector – Fall 2007

		BBSHHB				RBEP			MYSP	UNKN					
Night of	Operated Okay?	big brown bat	hoary bat	silver-haired bat	silver-haired/big brown	eastern pipistrelle	eastern red bat	pipistrelle/red bat	MYSP	high-frequency	low-frequency	unknown	Total	Relative Humidity (%)	Temperature (celsius)
8/2/07	y							1	2	2			5		
8/3/07	y												0		
8/4/07	y								3	3			6		
8/5/07	y								1				1		
8/6/07	y								2				2		
8/7/07	y				1				2	1			4		
8/8/07	y												0		
8/9/07	y								4	4			8		
8/10/07	y					1			2	1			4		
8/11/07	y								2	2			4		
8/12/07	y								1	2			3		
8/13/07	y									1			1		
8/14/07	y												0		
8/15/07	y												0		
8/16/07	y												0		
8/17/07	y												0		
8/18/07	y												0		
8/19/07	n												n/o		
8/20/07	n												n/o	48.8	19.3
8/21/07	n												n/o	50.0	13.0
8/22/07	y												0	66.9	13.8
8/23/07	y									1			1	86.7	14.7
8/24/07	y												0	98.6	19.7
8/25/07	y												0	98.3	20.1
8/26/07	y				1				3	2			6	87.9	14.5
8/27/07	y								2	1			3	73.6	15.0
8/28/07	y												0	67.0	17.1
8/29/07	y												0	78.0	18.1
8/30/07	y								1				1	98.2	13.8
8/31/07	y								1	3			4	97.1	11.2
9/1/07	y									1			1	80.0	8.8
9/2/07	y									1			1	73.4	13.5
9/3/07	y												0	74.9	14.2
9/4/07	y								1				1	69.9	8.0
9/5/07	y								1				1	66.5	8.9
9/6/07	y								1	2			3	82.8	13.8
9/7/07	y								2	3		1	6	80.2	21.8
9/8/07	y									1			1	79.3	12.7
9/9/07	y		1						1	2			4	94.0	12.1
9/10/07	y												0	98.1	12.8
9/11/07	y												0	99.0	13.4
9/12/07	y												0	78.5	8.7
9/13/07	y												0	61.6	7.6
9/14/07	y												0	91.4	11.7
9/15/07	y								1				1	96.4	5.3
9/16/07	y												0	80.0	5.3
9/17/07	y								3	1			4	65.6	10.5
9/18/07	y								1	1			2	69.1	11.8
9/19/07	y								1	1			2	82.0	12.2
9/20/07	y								5	1			6	82.2	12.2
9/21/07	y				1				1				2	87.4	14.7
9/22/07	y												0	94.4	13.5
9/23/07	y												0	55.8	9.3
9/24/07	y								3				3	43.1	12.0
9/25/07	y									2			2	69.4	21.8
9/26/07	n												n/o	82.2	15.5
9/27/07	n												n/o	97.2	15.9
9/28/07	n												n/o	97.3	7.1
9/29/07	n												n/o	75.5	3.7
9/30/07	n												n/o	67.3	8.0
10/1/07	n												n/o	93.6	9.6
10/2/07	n												n/o	87.9	11.7
10/3/07	n												n/o	93.6	15.7
10/4/07	n												n/o	57.7	13.2
10/5/07	n												n/o	62.2	14.6
10/6/07	n												n/o	61.9	7.0
10/7/07	n												n/o	71.0	3.5
10/8/07	n												n/o	90.7	5.2
10/9/07	n												n/o	88.6	7.0
10/10/07	n												n/o	97.9	6.5
10/11/07	n												n/o	98.5	8.4
10/12/07	n												n/o	99.1	8.6
10/13/07	n												n/o	88.3	3.6
10/14/07	n												n/o	97.2	1.3
10/15/07	n												n/o	86.8	2.9
10/16/07	n												n/o	80.4	3.6
10/17/07	n												n/o	75.3	5.7
10/18/07	n												n/o	61.1	11.1
10/19/07	n												n/o	98.4	14.9
10/20/07	n												n/o	78.3	11.5
10/21/07	n												n/o	57.2	14.9
10/22/07	n												n/o	52.2	17.4
10/23/07	n												n/o	95.9	9.8
10/24/07	n												n/o	84.6	3.7
10/25/07	n												n/o	72.2	1.8
10/26/07	n												n/o	74.2	6.2
10/27/07	n												n/o	96.1	12.4
10/28/07	n												n/o	67.6	-1.1
10/29/07	n												n/o	77.1	-0.7
10/30/07	n												n/o	76.4	-0.8
10/31/07	n												n/o	87.2	9.0
11/1/07	n												n/o	72.6	4.5
By Species		0	1	0	3	1	0	1	47	39	0	1	93		
By Guild		4 BBSHHB				2 RBEP			47 MYSP	40 UNKN			Total		

n/o - indicates that detector was not operating on that night

Appendix A Table 3. Summary of acoustic bat data and weather during each survey night at the Sam Drew Tree detector – Fall 2007

		BBSHHB				RBEP			MYSP	UNKN					
Night of	Operated Okay?	big brown bat	hoary bat	silver-haired bat	silver-haired/big brown	eastern pipistrelle	eastern red bat	pipistrelle/red bat	MYSP	high-frequency	low-frequency	unknown	Total	Relative Humidity (%)	Temperature (celsius)
8/2/07	y				1				15	13			29		
8/3/07	y								1	4			5		
8/4/07	y				2	1		1	9	4			17		
8/5/07	y				1				5	13			19		
8/6/07	y									1			1		
8/7/07	y				1				6	3			10		
8/8/07	y												0		
8/9/07	y							1	1	6			8		
8/10/07	y								3	1			4		
8/11/07	y									5			5		
8/12/07	y								3	5			8		
8/13/07	y								1	1			2		
8/14/07	y							2	3	3			8		
8/15/07	y									2			2		
8/16/07	y								1				1		
8/17/07	y												0		
8/18/07	y												0		
8/19/07	y												0		
8/20/07	y								1	1			2	48.8	19.3
8/21/07	y				1				5	10			16	50.0	13.0
8/22/07	y					1			5	3			9	66.9	13.8
8/23/07	y								1	1			2	86.7	14.7
8/24/07	y												0	98.6	19.7
8/25/07	y								1	1			2	98.3	20.1
8/26/07	y								3	4			7	87.9	14.5
8/27/07	y								2	3	1		6	73.6	15.0
8/28/07	y								1	1			2	67.0	17.1
8/29/07	y									3			3	78.0	18.1
8/30/07	y												0	98.2	13.8
8/31/07	y												0	97.1	11.2
9/1/07	y												0	80.0	8.8
9/2/07	y									1			1	73.4	13.5
9/3/07	y								2	3	1		6	74.9	14.2
9/4/07	y												0	69.9	8.0
9/5/07	y								1				1	66.5	8.9
9/6/07	y												0	82.8	13.8
9/7/07	y								1		1		2	80.2	21.8
9/8/07	y												0	79.3	12.7
9/9/07	y								1				1	94.0	12.1
9/10/07	y												0	98.1	12.8
9/11/07	y												0	99.0	13.4
9/12/07	y												0	78.5	8.7
9/13/07	y										1		1	61.6	7.6
9/14/07	y												0	91.4	11.7
9/15/07	y										1		1	96.4	5.3
9/16/07	y												0	80.0	5.3
9/17/07	y												0	65.6	10.5
9/18/07	y												0	89.1	11.8
9/19/07	y				1								1	82.0	12.2
9/20/07	y								1				1	82.2	12.2
9/21/07	y									1			1	87.4	14.7
9/22/07	y												0	94.4	13.5
9/23/07	y									1			1	55.8	9.3
9/24/07	y									1			1	43.1	12.0
9/25/07	y								1				1	69.4	21.8
By Species		0	0	0	7	2	0	4	74	95	5	0	187		
By Guild		7				6			74	100					
		BBSHHB				RBEP			MYSP	UNKN			Total		

n/o - indicates that detector was not operating on that night

Appendix A Table 4. Summary of acoustic bat data and weather during each survey night at the Valley Tree detector – Fall 2007

		BBSHHB				RBEP			MYSP	UNKN					
Night of	Operated Okay?	big brown bat	hoary bat	silver-haired bat	silver-haired/big brown	eastern pipistrelle	eastern red bat	pipistrelle/red bat	MYSP	high-frequency	low-frequency	unknown	Total	Relative Humidity (%)	Temperature (celsius)
8/2/07	y								8	24		6	38		
8/3/07	y								9	10		4	23		
8/4/07	y									10		3	13		
8/5/07	y									3	1	2	6		
8/6/07	y								6	11		7	24		
8/7/07	y								32	19		7	58		
8/8/07	y								1	3	1	1	6		
8/9/07	y								1			1	2		
8/10/07	y								5	9			14		
8/11/07	y								5	13			18		
8/12/07	y								6	7		2	15		
8/13/07	y								1	1		5	7		
8/14/07	y									2		3	5		
8/15/07	y								1	1			2		
8/16/07	y								1	18		1	20		
8/17/07	y								1	4	1	1	7		
8/18/07	y									2			2		
8/19/07	y												0		
8/20/07	y									1	1		2	48.6	19.3
8/21/07	y									2	1		3	50.0	13.0
8/22/07	y								6	7		1	14	66.9	13.8
8/23/07	n												0	86.7	14.7
8/24/07	n												0	98.6	19.7
8/25/07	n												0	98.3	20.1
8/26/07	n												0	87.9	14.5
8/27/07	n												0	73.6	15.0
8/28/07	n												0	67.0	17.1
8/29/07	n												0	78.0	18.1
8/30/07	n												0	98.2	13.6
8/31/07	n												0	97.1	11.2
9/1/07	n												0	60.0	6.6
9/2/07	n												0	73.4	13.5
9/3/07	n												0	74.9	14.2
9/4/07	y								1				1	69.9	8.0
9/5/07	y									1			1	66.5	8.9
9/6/07	y								7	3	2		12	82.8	13.8
9/7/07	y								26	12	1		39	80.2	21.8
9/8/07	y								20	11	1		32	79.3	12.7
9/9/07	y								5		1		6	94.0	12.1
9/10/07	y								3	3			6	98.1	12.8
9/11/07	y								1		1		2	99.0	13.4
9/12/07	y								2	1	3		6	78.5	8.7
9/13/07	y								1				1	61.6	7.6
9/14/07	y								11	1			12	91.4	11.7
9/15/07	y								4	2			6	96.4	5.3
9/16/07	y												0	80.0	5.3
9/17/07	y									1			1	65.6	10.5
9/18/07	y								3	1	1		5	69.1	11.8
9/19/07	y								37	3	2		42	82.0	12.2
9/20/07	y								4				4	82.2	12.2
9/21/07	y								1				1	87.4	14.7
9/22/07	y												0	94.4	13.5
9/23/07	y												0	55.8	9.3
9/24/07	y												0	43.1	12.0
9/25/07	y												0	69.4	21.8
By Species		0	0	0	0	0	0	0	209	186	17	44	456		
By Guild		0				0			209	247					
		BBSHHB				RBEP			MYSP	UNKN			Total		

n/o - indicates that detector was not operating on that night

Appendix A Table 5. Summary of acoustic bat data and weather during each survey night at the Met High detector – Fall 2007

		BBSHHB				RBEP			MYSP	UNKN					
Night of	Operated Okay?	big brown bat	hoary bat	silver-haired bat	silver-haired/big brown	eastern pipistrelle	eastern red bat	pipistrelle/red bat	MYSP	high-frequency	low-frequency	unknown	Total	Relative Humidity (%)	Temperature (celsius)
9/26/07	y												0	82.2	15.5
9/27/07	y												0	97.2	15.9
9/28/07	y												0	97.3	7.1
9/29/07	y												0	75.5	3.7
9/30/07	y												0	67.3	8.0
10/1/07	y												0	93.6	9.6
10/2/07	y												0	87.9	11.7
10/3/07	y												0	93.6	15.7
10/4/07	y												0	57.7	13.2
10/5/07	y												0	62.2	14.6
10/6/07	y												0	61.9	7.0
10/7/07	y												0	71.0	3.5
10/8/07	y												0	90.7	5.2
10/9/07	y												0	88.6	7.0
10/10/07	y												0	97.9	8.5
10/11/07	y												0	98.5	8.4
10/12/07	y												0	99.1	8.6
10/13/07	y												0	88.3	3.6
10/14/07	y												0	97.2	1.3
10/15/07	y												0	86.8	2.9
10/16/07	y												0	80.4	3.6
10/17/07	y												0	75.3	5.7
10/18/07	y												0	61.1	11.1
10/19/07	y												0	98.4	14.9
10/20/07	y												0	78.3	11.5
10/21/07	y												0	57.2	14.9
10/22/07	y												0	52.2	17.4
10/23/07	y												0	95.9	9.8
10/24/07	y												0	84.6	3.7
10/25/07	y												0	72.2	1.8
10/26/07	y												0	74.2	6.2
10/27/07	y												0	96.1	12.4
10/28/07	y												0	67.6	-1.1
10/29/07	y												0	77.1	-0.7
10/30/07	y												0	76.4	-0.8
10/31/07	y												0	87.2	9.0
11/1/07	y												0	72.6	4.5
By Species		0	0	0	0	0	0	0	0	0	0	0	0		
By Guild		0				0			0	0					
		BBSHHB				RBEP			MYSP	UNKN			Total		

n/o - indicates that detector was not operating on that night

Appendix A Table 6. Summary of acoustic bat data and weather during each survey night at the Met Low detector – Fall 2007

		BBSHHB				RBEP			MYSP	UNKN					
Night of	Operated Okay?	big brown bat	hoary bat	silver-haired bat	silver-haired/big brown	eastern pipistrelle	eastern red bat	pipistrelle/red bat	MYSP	high-frequency	low-frequency	unknown	Total	Relative Humidity (%)	Temperature (celsius)
9/26/07	n												n/o	82.2	15.5
9/27/07	n												n/o	97.2	15.9
9/28/07	n												n/o	97.3	7.1
9/29/07	n												n/o	75.5	3.7
9/30/07	n												n/o	67.3	8.0
10/1/07	n												n/o	93.6	9.6
10/2/07	n												n/o	97.9	11.7
10/3/07	n												n/o	93.6	15.7
10/4/07	n												n/o	57.7	13.2
10/5/07	n												n/o	62.2	14.6
10/6/07	n												n/o	61.9	7.0
10/7/07	n												n/o	71.0	3.5
10/8/07	n												n/o	90.7	5.2
10/9/07	n												n/o	88.6	7.0
10/10/07	n												n/o	97.9	8.5
10/11/07	n												n/o	98.5	8.4
10/12/07	n												n/o	99.1	8.6
10/13/07	n												n/o	88.3	3.6
10/14/07	n												n/o	97.2	1.3
10/15/07	n												n/o	86.8	2.9
10/16/07	n												n/o	80.4	3.6
10/17/07	n												n/o	75.3	5.7
10/18/07	n												n/o	61.1	11.1
10/19/07	n												n/o	98.4	14.9
10/20/07	n												n/o	78.3	11.5
10/21/07	n												n/o	57.2	14.9
10/22/07	n												n/o	52.2	17.4
10/23/07	n												n/o	95.9	9.8
10/24/07	n												n/o	84.6	3.7
10/25/07	n												n/o	72.2	1.8
10/26/07	n												n/o	74.2	6.2
10/27/07	n												n/o	96.1	12.4
10/28/07	n												n/o	67.6	-1.1
10/29/07	n												n/o	77.1	-0.7
10/30/07	n												n/o	76.4	-0.8
10/31/07	n												n/o	87.2	9.0
11/1/07	n												n/o	72.6	4.5
By Species		0	0	0	0	0	0	0	0	0	0	0	0		
By Guild		0				0			0	0					
		BBSHHB				RBEP			MYSP	UNKN			Total		

n/o - indicates that detector was not operating on that night

Appendix 7-5
Spring and Summer 2008 Bird and Bat Migration Survey Report for the Oakfield Wind Project, Oakfield, Maine

Spring and Summer 2008 Bird and Bat Migration Survey Report

Visual, Radar, and Acoustic Bat Surveys for the Oakfield Wind Project in Oakfield, Maine

Prepared for

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Prepared by

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January 2009

Executive Summary

During spring and summer 2008, Stantec Consulting (Stantec) conducted field surveys of bird and bat migration activity at the Oakfield wind project area in Oakfield, Maine. The surveys are part of the planning process by First Wind Energy, LLC (First Wind) for a proposed wind project (Project). These surveys represented the second season of investigations undertaken at this site. The results of the field surveys provide useful information about site-specific migration activity and patterns in the vicinity of the Project area, including species composition and timing.

Nocturnal Radar Survey

The spring 2008 field survey targeted 20 nights of nocturnal radar sampling between April 15 and June 7. Surveys were delayed, however, until May 1 due to the presence of significant snow-pack and subsequent area flooding. Surveys were conducted using X-band radar, sampling from sunset to sunrise. Each hour of sampling included the recording of radar video files during horizontal and vertical operation. The radar location at the summit of Sam Drew Mountain, the highest point within the Project area, allowed for unobstructed views nearly 360 degrees around the radar. The topography and tree height at this location also allowed for some limited views to the east/southeast below the height of the radar in the valley below.

The overall passage rate for the entire survey period was 498 targets per kilometer per hour (t/km/hr) with single nightly passage rates varying from 132 t/km/hr to 899 t/km/hr. Mean flight direction through the Project area was 33° ± 65°.

The mean flight height of targets was 276 meters (m) (905 feet [']) above the radar site. The average nightly flight height ranged from 111 m (364') to 519 m (1703'). The percent of targets observed flying below 120 m (394'), the maximum projected height of the proposed turbines, was 21 percent.

The mean flight direction, qualitative analysis of the surrounding topography and landscape, and mean flight altitude of targets passing over the Project area together indicate that avian migration in this area involves a broad front type of landscape movement, rather than a concentration or funneling of flight movements over or through any particular part of the Project area. This type of broad front movement, particularly in conjunction with the high flight heights, demonstrates a limited avian mortality risk during spring migration. Additionally, the flight height of targets indicates that the vast majority of bird migration in the area occurs well above the height of the proposed wind turbines.

Bat Survey

The spring and summer field surveys included documentation of bat activity through passive surveys with six acoustic detectors, resulting in 565 detector-nights of recordings from April 25 to August 11. Two detectors were deployed in a meteorological measurement tower for the entire survey period, two detectors were deployed in trees for the entire survey period, and two detectors were placed in trees for part of the survey period and subsequently moved to a met tower. During the spring survey, a total of 600 bat call sequences were recorded, with a mean detection rate for all detectors of 3.8 detections per detector-night. The mean rate for tree detectors was higher (6.8 detections per detector-night) than the mean rate for the met tower detectors (0.2 detections per detector-night). During the summer survey, a total of 6,103 call sequences were recorded, with a mean detection rate for all detectors of 15.0 detections per detector-night. The mean rate for tree detectors was higher (30.5 detections per detector-night) than for the met tower detectors (1.1 detections per detector-night).

Bat calls were identified to the lowest possible taxonomic level. These were then grouped into four guilds based on similarity in call characteristics between some species and the uncertainty in the ability of frequency division detectors to adequately provide information for this differentiation. In both seasons, the majority of calls (62% in the spring, 68% in the summer) were identified as *Myotis*. Approximately one-third of all calls could not be identified (38% in the spring 32% in the summer) and less than one percent of calls were identified as species in the red bat/eastern pipistrelle guild or big brown guild. This trend in species composition is similar to that of other studies in the region.

Diurnal Raptor Survey

In addition to the nocturnal radar and passive bat surveys, a total of 12 days of diurnal raptor surveys (79 hours of observation) were conducted from an observation point at the summit of Sam Drew Mountain. Surveys were conducted generally between 9:00 am and 4:00 pm on days with weather conditions favorable for migration. A total of seven species, involving 58 individual birds, were seen, with an overall passage rate of 0.7 raptors per observation-hour. The flight heights of raptors in the Project area indicate that 76 percent of the observations occurred below 120 m above the ground; however, only 32 percent were observed directly over the project ridgeline. Differences between species were observed and are likely due to typical flight height preferences, species behavior, or to limitations in the distance that different species are visible. Despite this, the greater occurrence of migrants at low altitudes increases the potential for migrating raptors to encounter proposed wind turbines; however, diurnal activity patterns and raptor avoidance patterns make these encounters less likely despite the reported low flight heights.

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1.0 Introduction

This report has been prepared to document and discuss observed avian and bat activity patterns and species composition within the proposed Oakfield wind project area (Figure 1-1).

In advance of permitting activities for this Project, First Wind contracted Stantec Consulting, (Stantec) formerly Woodlot Alternatives, Inc.[1], to conduct avian and bat surveys to determine the presence and, when possible, species composition of birds and bats in the Project area. The scope of these surveys was based on a combination of standard methods that are developing within the wind power industry for pre-construction surveys and is consistent with a number of other studies conducted recently in Maine and throughout the Northeast region of the United States.

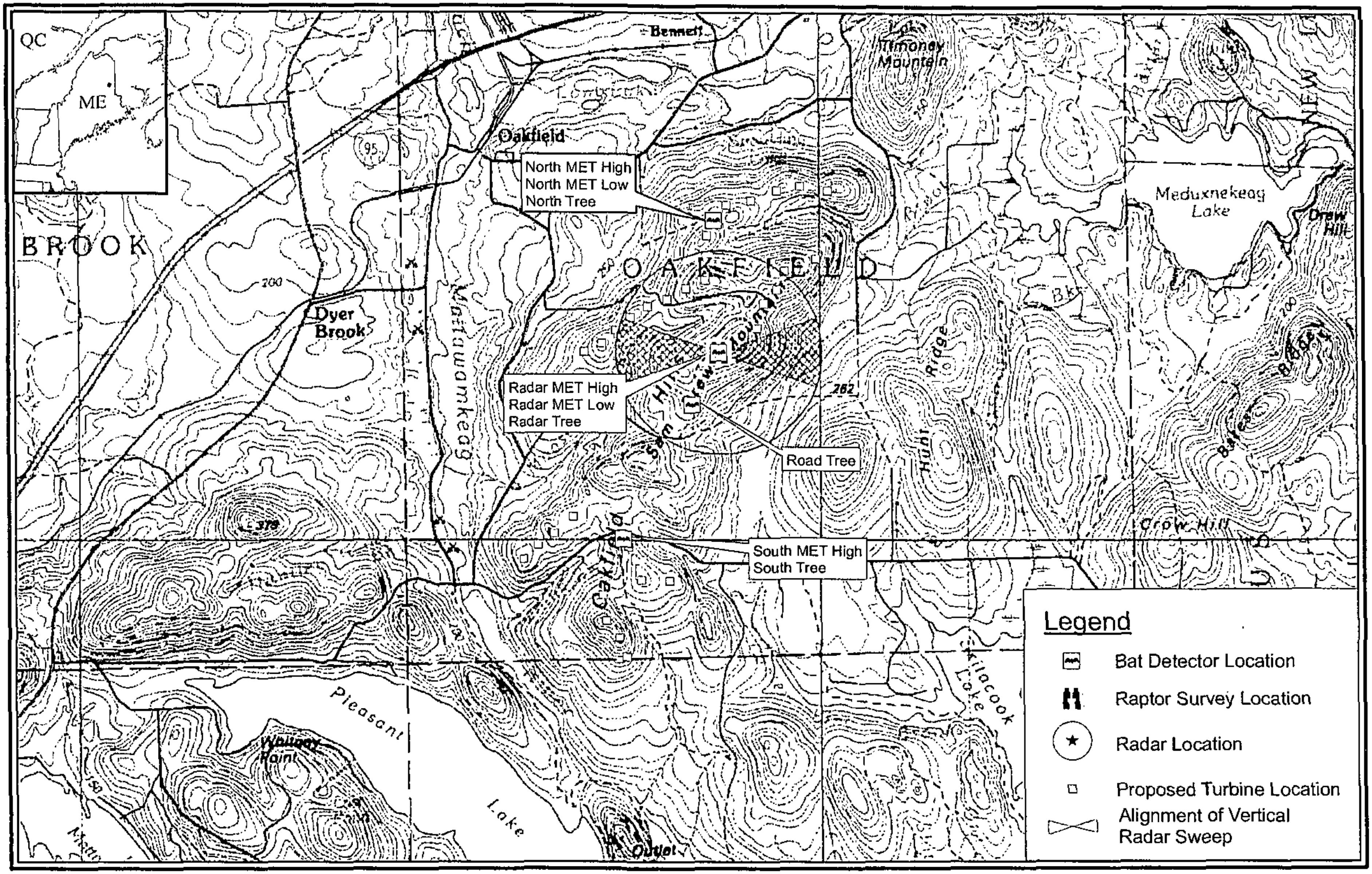
1.1 SURVEY OVERVIEW

Stantec conducted field investigations, or surveys, for bird and bat migration during spring and summer 2008. The overall goals of the investigations were to document:

- passage rates for nocturnal migration in the vicinity of the Project area during spring, including the number of migrants, their flight direction, and their flight altitude;
- activity patterns of bats in the Project area during spring and summer, including the rate of occurrence and relationship with weather factors;
- and passage rates and species composition of raptors during spring migration through the Project area.

The following sections outline the survey methodology and results contributing toward the achievement of survey goals. Discussion of survey results and subsequent conclusions follow each section.

[1] On October 1, 2007, Woodlot Alternatives, Inc. was formally acquired by Stantec Consulting Services, Inc.



Prepared By:

Stantec

195600152-F101-SurveyLocation.mxd

Sheet Title:

Project and Survey Location Map Spring & Summer 2008

Project:

Oakfield Wind Project
Oakfield, Maine

0 6,000
Feet

Date: December 18, 2008

Scale: 1" = 6000'

Proj. No.: 195600152

Figure:

1.1

2.0 Nocturnal Radar Survey

2.1 INTRODUCTION

The majority of North American passerines migrate at night. The strategy to migrate at night may have evolved to take advantage of more stable atmospheric conditions for flapping flight (Kerlinger 1995). Additionally, night migration may provide a more efficient medium to regulate body temperature during active, flapping flight and could reduce the potential for predation while in flight (Alerstam 1990, Kerlinger 1995). Conversely, species, such as raptors, that use soaring flight migrate during the day to take advantage of warm rising air in thermals and laminar flow of air over the landscape, which can create updrafts along hillsides and ridgelines. Whereas raptor migration can be documented by visual daytime surveys, documenting the patterns of nocturnally migrating birds requires the use of radar or other non-visual technologies. Nocturnal radar surveys were conducted in the Project area to characterize spring nocturnal migration patterns. The goal of the surveys was to document the overall passage rates for nocturnal migration in the vicinity of the Project area, including the number of migrants, their flight direction, and their flight altitude relative to the ground elevation at the radar site on the ridgeline.

2.2 METHODS

The radar study was conducted from the summit of Sam Drew Mountain (Figure 1-1).

Marine surveillance radar, similar to that described by Cooper *et al.* (1991), was used during field data collection. The radar has a peak power output of 12 kilowatts (kW) and has the ability to track small animals, including birds, bats, and even insects, based on settings selected for the radar functions. It cannot, however, readily distinguish between different types of animals being detected. Consequently, all animals observed on the radar screen were identified as "targets." The radar has an "echo trail" function which captures past echoes of flight trails, enabling determination of flight direction. During all operations, the radar's echo trail was set to 30 seconds. The radar was equipped with a 2 m (6.5') waveguide antenna. The antenna has a vertical beam height of 20° (10° above and below horizontal), and the front end of the antenna was inclined approximately 5° to increase the proportion of the beam directed into the sky. Objects on the ground detected by the radar cause returns on the radar screen (echoes) that appear as blotches called ground clutter. Large amounts of ground clutter reduce the ability of the radar to track birds and bats flying over those areas. However, vegetation and hilltops near the radar can be used to reduce or eliminate ground clutter by "hiding" clutter-causing objects from the radar. These nearby features also cause ground clutter, but their proximity to the radar antenna generally limits the ground clutter to the center of the radar screen (Figure 2-1). The presence or reduction of potential clutter producing objects was carefully considered during site selection and radar station configuration.

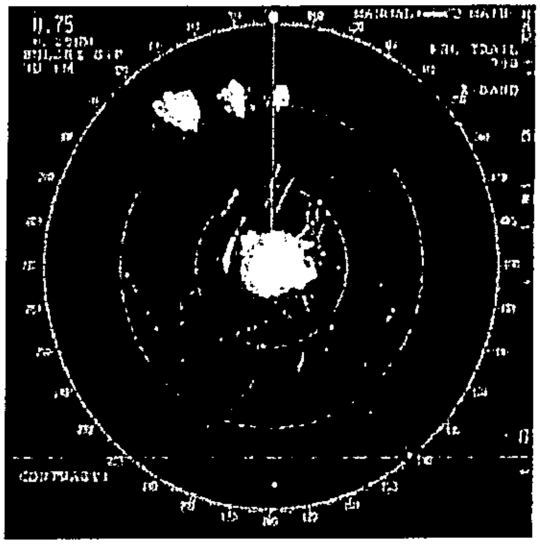


Figure 2-1. Ground clutter in Project area

Radar surveys were typically conducted from sunset to sunrise. Twenty nights of surveys were targeted between April 15 and June 7. Because the anti-rain function of the radar must be turned down to detect small songbirds and bats, surveys could not be conducted during periods of inclement weather. Therefore, surveys were planned largely for nights without rain. However, in order to characterize migration patterns during nights without optimal conditions, some nights with weather forecasts including occasional showers were sampled.

The radar was operated in two modes throughout the night. In surveillance mode, the antenna spins horizontally to survey the airspace around the radar and detects targets moving through the area. By analyzing the echo trail, the flight direction of targets can be determined. In vertical mode, the radar unit is tilted 90° to vertically survey the airspace above the radar (Harmata *et al.* 1999). In vertical mode, target echoes do not provide directional data, but do provide information on the altitude of targets passing through the vertical, 20° radar beam. Both modes of operation were used during each hour of sampling.

The radar was operated at a range of 1.4 km (0.75 nautical miles). At this range, the echoes of small birds can be easily detected, observed, and tracked. At greater ranges, larger birds can be detected, but the echoes of small birds are reduced in size and restricted to a smaller portion of the radar screen, thus limiting the ability to observe the movement pattern of individual targets.

2.2.1 Data Collection

The radar display was connected to the video recording software of a computer enabling digital archiving of the radar data for subsequent analysis. This software recorded and archived video samples continuously every hour from sunset to sunrise of each survey night. Alternating the radar antenna every ten minutes from vertical mode to horizontal mode, a total of 30 minutes of vertical samples and 30 minutes of horizontal samples were collected within each hour. Video recordings were subsequently analyzed based on a random schedule for each night.

During each hour, additional information was also recorded, including weather conditions and ceilometer and/or night-vision goggle observations. Ceilometer observations involved directing a one-million candlepower spotlight vertically into the sky in a manner similar to that described by Gauthreaux (1969). The ceilometer beam was observed by eye for 5 minutes to document and characterize low-flying targets. The ceilometer was held in-hand so that any birds, bats, or insects passing through it could be tracked for several seconds, if needed; surveys were conducted from the radar survey site. Observations from each ceilometer observation period were recorded, including the number of birds, bats, and insects observed. This information was used during data analysis to help characterize activity of insects, birds, and bats.

2.2.2 Data Analysis

Video samples were analyzed using a digital analysis software tool developed by Woodlot Alternatives, Inc.[2] For horizontal samples, targets (either birds or bats) were differentiated from insects based on their flight speed. Following adjustment for wind speed and direction, targets traveling faster than approximately 6 m (20') per second were identified as a bird or bat target (Larkin 1991, Bruderer and Boldt 2001). The software tool recorded the time, location, and flight vector for each target traveling fast enough to be a bird or bat within each horizontal sample, and these results were output to a spreadsheet. For vertical samples, the software tool recorded the entry point of targets passing through the vertical radar beam, the time, and flight altitude above the radar location, and then subsequently outputs the data to a spreadsheet. These datasets were then used to calculate passage rate (reported as targets per kilometer of migratory front per hour), flight direction, and flight altitude of targets.

Mean target flight directions (± 1 circular standard deviation) were summarized using software designed specifically to analyze directional data (Oriana2© Kovach Computing Services). The statistics used for this analysis are based on those used by Batschelet (1965), because they take into account the circular nature of the data. Nightly wind direction was also summarized using similar methods and data, which was collected from the nearest meteorological measurement tower (met tower) to the radar.

Flight altitude data were summarized using linear statistics. Mean flight altitudes (± 1 standard error [SE]) were calculated by hour, night, and overall season. The percent of targets flying below 120 meters, the approximate maximum height of the proposed wind turbines with blades, was also calculated hourly, for each night, and for the entire survey period.

[2]All field work and any reporting and permitting activities performed prior to October 1, 2007, were conducted as Woodlot Alternatives, Inc. and will be herein referenced as work done by Woodlot. On October 1, 2007, Woodlot Alternatives, Inc. was acquired by Stantec Consulting Services, Inc. Work conducted on or after October 1, 2007 is herein referenced as work done by Stantec.

2.2.3 Weather Data

Weather data was collected from an anemometer on the met tower at the summit of Sam Drew Mountain between April 25 and June 7. Additional data was also collected from an on site weather station deployed at the radar location during this same timeframe. For reporting purposes, wind direction and wind speed was recorded by the anemometer. Temperature was recorded by data loggers (HOBO Pro v2 U23-001, Onset Computer Corporation). The mean wind direction, wind speed, and temperature were calculated for each night.

2.2.4 NEXRAD Radar Data Analysis

NEXRAD weather radar images from the National Weather Service station in Houlton, Maine (selected for its proximity to the Project area and ability to provide adequate radar coverage) were examined on the dates surrounding the typical spring migration period (April 15 to June 15). These radar images were then used to confirm that the nights selected for the on-site radar sampling period were representative of seasonal migration activity throughout the region. NEXRAD radar provides a different type of data than the marine surveillance radar used on-site. This long-range Doppler radar produces reflectivity data on objects (and precipitation) in the sky, as well as the velocity of those objects. Because it covers such a large area, it does not track individual birds, but can be used to interpret large-scale bird migration patterns and the level of migration activity (Gauthreaux and Belser 1998).

Nightly samples of reflectivity and velocity images were obtained from the National Oceanic and Atmosphere Administration (NOAA 2007) and visually assessed to determine the overall intensity of nightly migration. Each night was qualitatively categorized as: 1) no biological activity (very low activity or rainy nights); 2) light biological activity; or 3) moderate to heavy biological activity (Figure 2-2). These determinations were made based on the color-coded strength of the radar reflectance data, velocity and direction, and winds aloft data. The images selected for this assessment were generally timed to be from two to four hours after sunset. For data interpretation purposes, bird migration is discernable from most precipitation. Bird activity was detected on some nights when rain occurred periodically. On those nights, radar reflectivity patterns indicative of migrating birds were observed forming and then dissolving during those periods between rain events. Nights exhibiting these conditions were classified as having light migration activity.

Once NEXRAD images were analyzed, nights of on-site surveys in the Project area were compared with those same nights of NEXRAD data to confirm on-site sampling occurred during periods of moderate to heavy migration. The remainder of the nightly NEXRAD data was then summarized to identify the proportion of nights with moderate to heavy migration activity within the entire season as compared to nights sampled with on-site radar.

Figure 2-2. Examples of NEXRAD radar images depicting (from left to right) rain, light migration, and moderate to heavy migration activity.

2.3 RESULTS

Radar surveys were conducted during 20 nights from May 1 to June 3, 2008 (Appendix A, Table 1). The beginning of the survey was delayed by the presence of a significant snowpack and subsequent flooding. Radar surveys were conducted from a 7m (23') tower next to the met tower at the summit of Sam Drew Mountain, the highest point within the Project area (Figure 1-1). At this location, the radar tower afforded unobstructed 360 degree views, although some small areas to the northwest were slightly obstructed due to "groundclutter" caused from the detection of the tree tops on the nearby ridgeline. As a result, the radar was able to detect targets moving over the northwestern quadrant flying at radar level or higher over the northwestern valley. The steep topography to the east and lower tree height on that side of the met tower opening also allowed for the detection of targets flying below the height of the radar over the eastern valley.

2.3.1 *Passage Rates*

The overall passage rate for the entire survey period was 498 targets per kilometer per hour (t/km/hr); individual nightly passage rates varied from 132 t/km/hr on May 1 to 899 t/km/h on May 26 (Figure 2-3; also Appendix A, Table 1). Individual hourly passage rates ranged from 0 to 1496 t/km/hr during the survey period (Appendix A, Table 1). Hourly passage rates were typically highest four to five hours after sunset. For the entire season, passage rates peaked two hours after sunset and decreased consistently until sunrise (Figure 2-4).

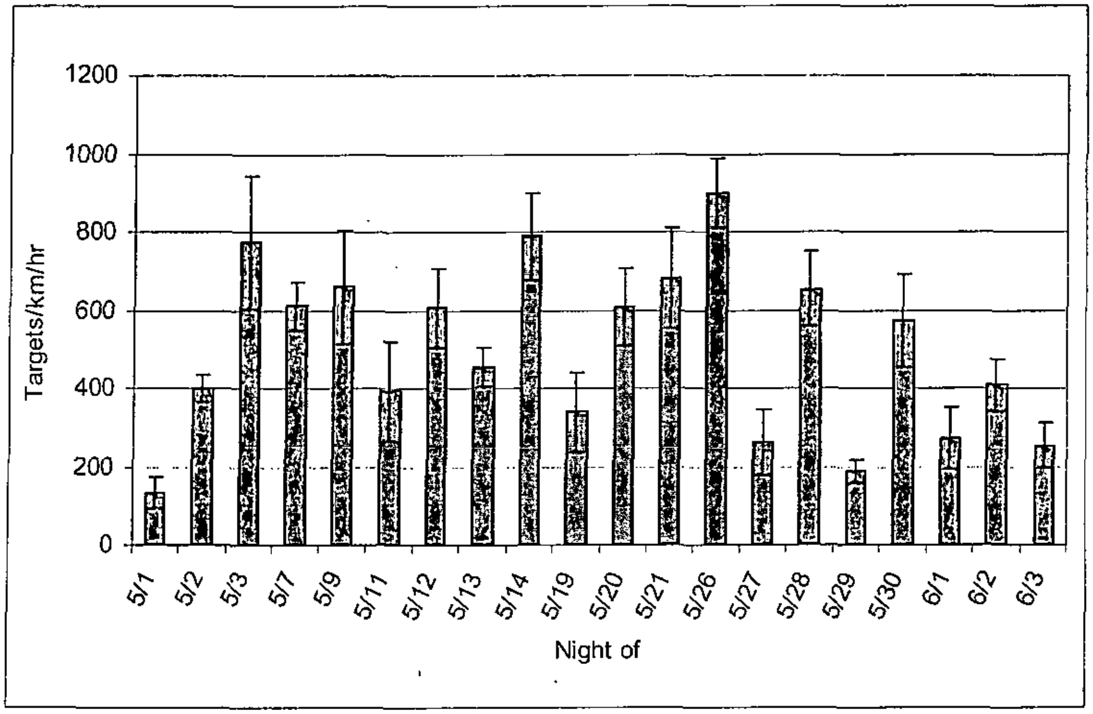


Figure 2-3. *Nightly passage rates observed (error bars ± 1 SE)*

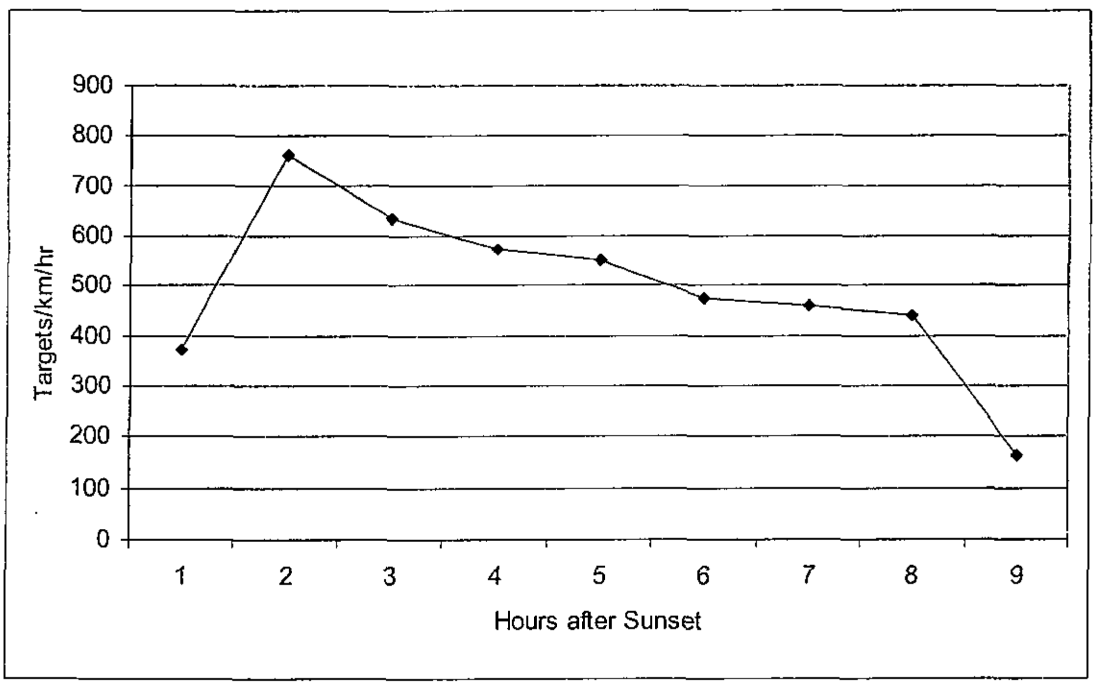


Figure 2-4. Hourly passage rates for entire season

2.3.2 Flight Direction

Mean flight direction through the Project area was 33° ± 65° (Figure 2-5). Although there was significant variation, most nights included movement generally to the north or northeast, as expected during spring migration periods (Appendix A, Table 2).

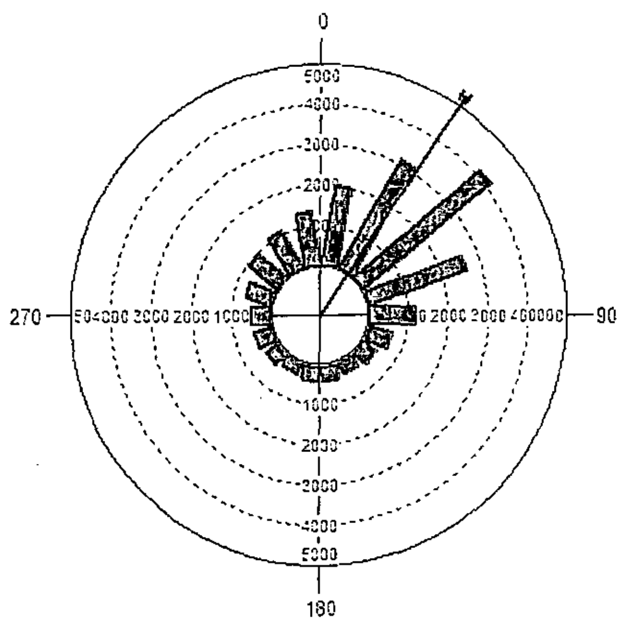


Figure 2-5. Mean flight direction for the entire season (the bracket along the margin of the histogram is the 95% confidence interval).

2.3.3 Flight Altitude

The seasonal average mean flight height of all targets was 276 m (905') above the radar site. The average nightly flight height ranged from 111 m (1703') on May 19 to 519 (364') on May 2 (Figure 2-6; Appendix A, Table 3). The percent of targets observed flying below 120 m (394'), the maximum turbine height, was 21%. Flight heights were relatively consistent throughout the night, with a decrease in flight height prior to sunrise (Figure 2-7; Figure 2-8).

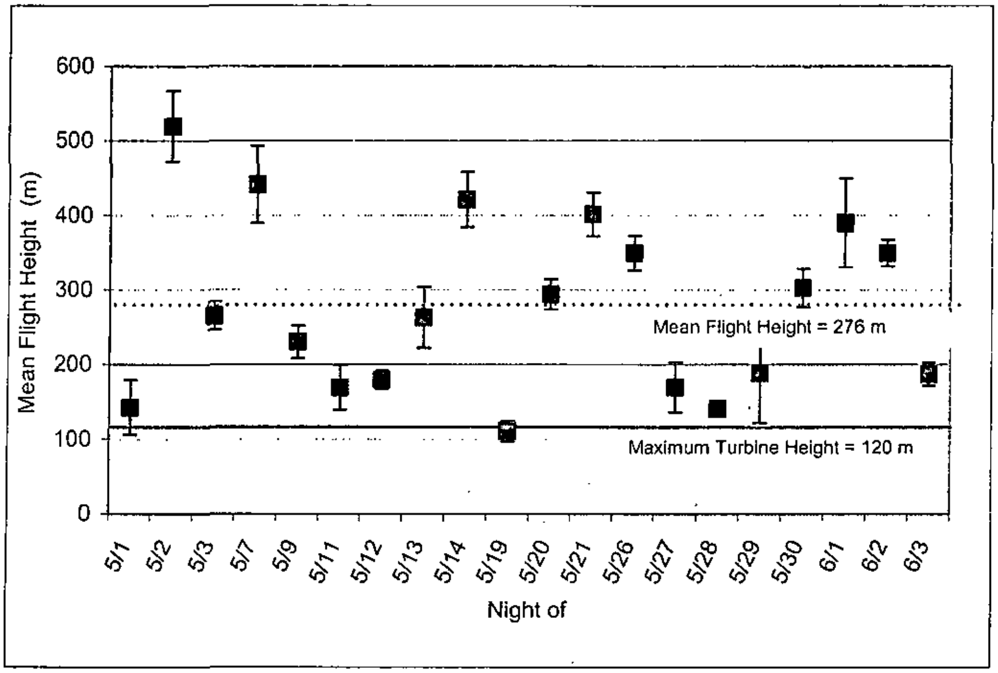


Figure 2-6. Mean nightly flight height of targets (error bars ± 1 SE)

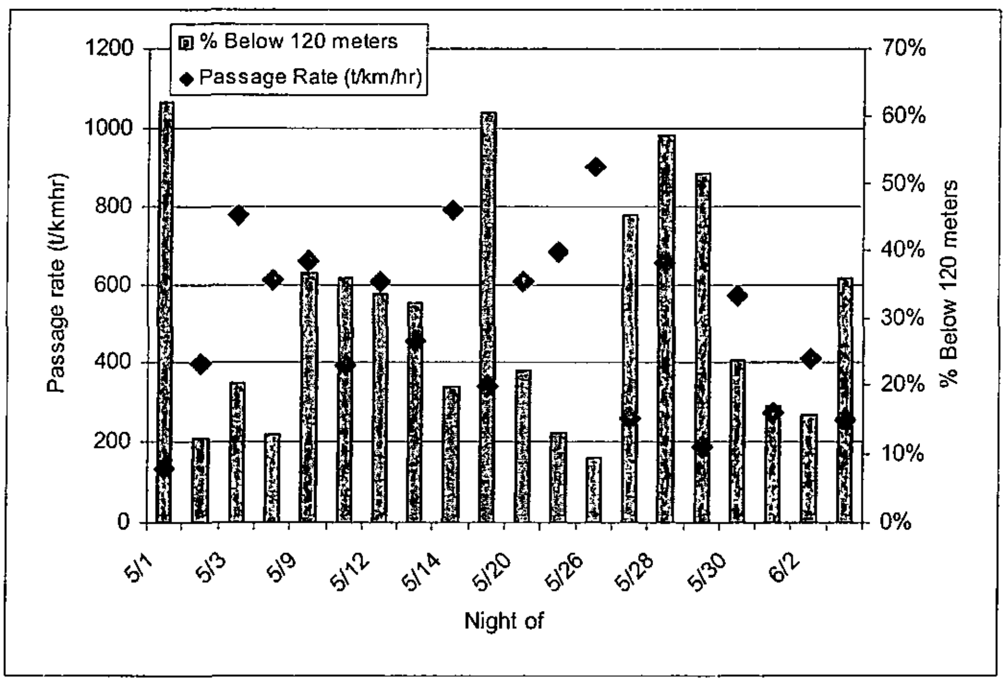


Figure 2-7. Percent of targets observed flying below a height of 120 m (394')

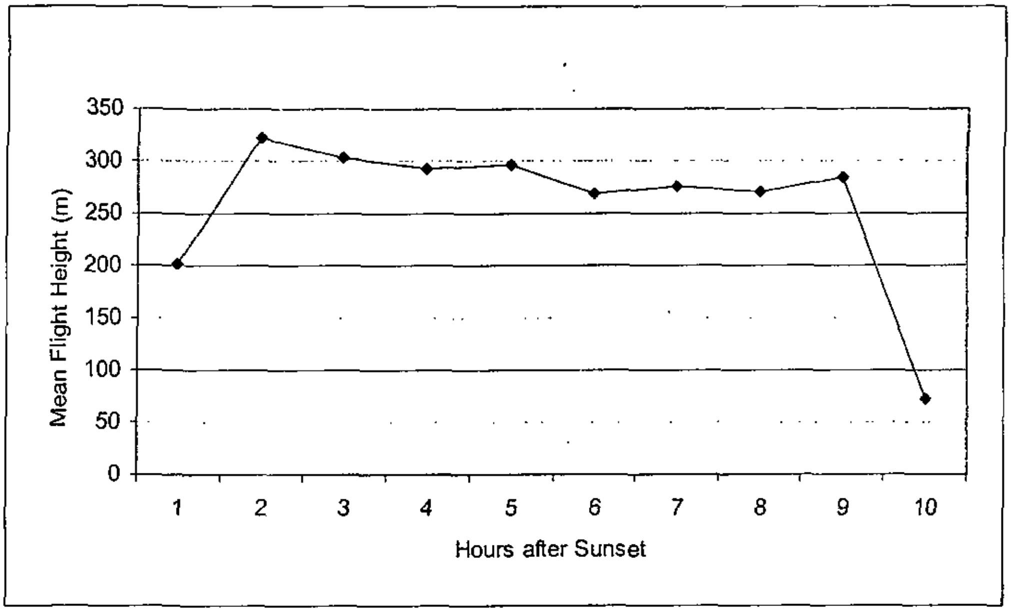


Figure 2-8. Hourly target flight height distribution

2.3.4 Night-vision Goggle Observations

Night-vision goggle data collected during the radar survey yielded a total of 54 5-minute observations during the last half of the survey period. Those observations included 37 birds and 65 bats.

2.3.5 Weather Data

Mean nightly wind speeds in the Project area from May 1 to June 3 ranged between 2.4 and 10.5 meters per second (m/s). Mean nightly temperatures varied between -1.3°C and 11.1°C.

2.3.6 NEXRAD Analysis

A total of 55 nights of NEXRAD data were analyzed from April 15 to June 15, 2008, dates considered to be the typical spring migration period. Detectable biological activity occurred on 44 of those nights, with 9 nights of no detectable biological activity due to prolonged intense rain and 2 nights where NEXRAD data was not available. There were 11 nights of light biological activity and 33 nights of moderate to heavy nights of biological activity. Moderate to heavy nights of biological activity indicated a distinct migration event was occurring, and were distinguished from nights of light activity when the type of biological activity was less distinct or apparent. Overall, NEXRAD data documented a greater proportion (60 percent) of nights with moderate to heavy biological activity. Likewise, during the 20 nights of on-site radar surveys, a greater proportion (62 percent) of sampling also occurred on nights with moderate to heavy biological activity (Table 2-1).

Table 2-1. Summary of NEXRAD and on-site radar data collection				
Migration Activity Category	**Number of nights (NEXRAD)**	**Percent of Migration Nights**	**Number of nights with on-site radar**	**Percent of on-site radar data set**
Rain	9	16%	3	14%
Light Migration	11	20%	4	19%
Moderate to Heavy Migration	33	60%	13	62%
Not Available	2	4%	1	5%

2.4 DISCUSSION

Considerable nightly variation in the magnitude and flight characteristics of nocturnally-migrating songbirds is typical and is often attributed to weather patterns, such as cold fronts and winds aloft (Hassler *et al.* 1963, Gauthreaux and Able 1970, Richardson 1972, Able 1973, Bingman *et al.* 1982, Gauthreaux 1991). Data from regional surveys using similar methods and equipment conducted within the last several years are rapidly becoming available, thus allowing an opportunity to compare the results from this area to other projects in the area. There are, however, limitations in comparing data from previous years with data from 2008, as year-to-year variation in continental bird populations may influence how many birds migrate through an area. Additionally, differences in site characteristics, particularly topography, local landscape conditions, and vegetation surrounding a radar survey location, can play a large role in any radar's ability to detect targets and the subsequent calculation of passage rate. These differences should be recognized as significant limiting factors in making direct site-to-site comparisons in passage rates.

Regardless of potential differences between radar survey locations, the nightly mean passage rates observed at the Project (498 t/km/hr) were within the upper range of other available studies that have been conducted to date within the local region (Table 2-2). There is currently no accurate quantitative method of directly correlating pre-construction passage rates at wind farms to operational impacts to birds and bats. Some research suggests that bird migration may be affected by landscape features, such as coastlines, large river valleys, and mountain ranges. This has been documented for diurnally migrating birds, such as raptors, but is not as well established for nocturnally migrating birds (Sielman *et al.* 1981; Bingman 1980; Bingman *et al.* 1982; Bruderer and Jenni 1990; Richardson 1998; Fortin *et al.* 1999; Williams *et al.*.2001; Diehl *et al.* 2003). However, studies suggesting night-migrating birds are influenced by topography have typically been conducted in areas of steep topography, such as the most rugged areas of the northern Appalachians and the Alps.

An emerging body of studies characterizing nocturnal bird movements shows a relatively consistent pattern in flight altitude, with most birds' flight occurring at altitudes of several hundred meters or more above the ground. Comparison of radar-derived flight height between survey sites as measured by radar is generally less influenced by site characteristics as the main portion of the radar beam is directed skyward, and the potential effects of surrounding vegetation on the radar's view can be more easily controlled. The range in mean flight heights is approximately 300 m (1,000') to 600 m (2,000') above the radar site. The percentage of targets documented at heights below the maximum turbine height is variable, but is typically within the range of 10 to 20 percent. The flight height documented in the Project area (276 m, 905') is within the range of other studies in the region. While the observed percentage of targets flying below the maximum turbine height was relatively high (21%), it was within the range of other local studies. The radar view in the Project area was also very good and included an easterly view shed that dropped approximately 122m (400') below the ridgeline elevation. Birds traveling thru the eastern valley would have been included in the radar viewshed and subsequently incorporated into the analysis.

2.5 CONCLUSIONS

Radar surveys during the spring 2008 migration period have provided important information on nocturnal bird migration patterns in the vicinity of the Project area. The results of the surveys indicate that bird migration patterns are generally similar to patterns observed at other sites in the northeastern U.S. region, especially other sites in Maine.

Migration activity varied throughout the season, which is likely largely attributable to weather patterns. The mean passage rate is generally within the upper range of passage rates observed at other regional sites studied with similar methods and equipment. The combination of the flight height and flight direction data indicates that the majority of migrants are unimpeded by topography and flying at significantly high elevations (relative to the proposed turbines and blade heights) and in a broadfront flight pattern.

3.0 Acoustic Bat Survey

Eight species of bats occur in Maine, based upon their normal geographical range. These are the little brown bat (*Myotis lucifugus*), northern long-eared bat, (*M. septentrionalis*), eastern small-footed bat (*M. leibii*), silver-haired bat (*Lasionycteris noctivagans*), eastern pipistrelle (*Perimyotis* = [*Pipistrellus*] *subflavus*), big brown bat (*Eptesicus fuscus*), eastern red bat (*Lasiurus borealis*), and hoary bat (*L. cinereus*) (BCI 2001). Of these, four are listed as species of Special Concern in Maine, including the small-footed bat, silver-haired bat, eastern red bat, and hoary bat. All but the eastern small-footed bat are believed to occur in most of the state;

the eastern small-footed bat is believed to be rare, but population size and trends are not well known for this species.

3.1 INTRODUCTION

To document bat activity patterns in the Project area, Stantec conducted acoustic monitoring surveys with Anabat detectors during spring and summer 2008, the second and third seasons of data collection at the Project. Acoustic bat detectors allow for long-term monitoring of activity patterns of bats in a variety of habitats, including the air space approaching the rotor-swept zone of modern wind turbines. The acoustic bat survey at Oakfield was designed to document bat activity patterns at various heights and in various locations throughout the Project area. Acoustic surveys were also intended to document bat activity patterns in relation to weather factors including wind speed, temperature, and relative humidity.

3.2 METHODS

3.2.1 Field Surveys

Four Anabat II and two SD 1 detectors (Titley Electronics Pty Ltd.) were used for the duration of the spring and summer 2008 acoustic bat surveys. Anabat detectors were selected based upon their widespread use for this type of survey, their ability to be deployed for long periods of time, and their ability to detect a broad frequency range, which allows detection of all species of bats that could occur in the Project area. Anabat detectors are frequency division detectors, dividing the frequency of ultrasonic calls made by bats by a factor of 16 so that they are audible to humans, which record the bat calls for subsequent analysis. The audio sensitivity setting of each Anabat system was set at between six and seven (on a scale of one to ten) to maximize sensitivity while limiting ambient background noise and interference. The sensitivity of individual detectors was then tested using an ultrasonic Bat Chirp (Reno, NV) to ensure that the detectors would be able to detect bats up to a distance of at least 10 m (33'). Each Anabat detector was coupled with CF Storage ZCAIM (Titley Electronics Pty Ltd.), which programmed the on/off times and stored data on removable 1 GB compact flash cards.

Detectors were powered by 12-volt batteries charged by solar panels. Each solar-powered Anabat system was deployed in a waterproof housing enabling the detector to record while unattended for the duration of the survey. The housing is designed to suspend the Anabat microphone downward to give maximum protection from precipitation. To compensate for the downward position, a reflector shield of smooth plastic is placed at a 45-degree angle directly below the microphone. The angled reflector allows the microphone to record the airspace horizontally surrounding the detector and is only slightly less sensitive than an unmodified Anabat unit. Maintenance visits were conducted approximately every two weeks to check on the condition of the detectors and to download the collected data to a computer for analysis.

Six bat detectors were deployed between April 25 to May 31 (spring) and between June 1 and August 11 (summer). Detectors were positioned in the proposed turbine areas along the ridge top that enabled comparative sampling of bat populations and bat activities directly within the local forest canopy as well as in the air space above the forest canopy, within the lower elevations of the rotor zone. Detectors were programmed to continuously record data from 7:00 pm to 7:00 am each night.

In the spring, two detectors were deployed in an existing met tower on the summit of Sam Drew Mountain and four detectors were deployed in trees throughout the Project area (Figure 1-1). During a portion of the summer survey, three of the tree detectors were moved to new met towers located throughout the Project area. The met tower detectors were placed at approximately 11 m (35') and 22 m (70') above the ground to survey near the proposed wind turbine rotor zone. The tree detectors were typically hung 3-5 m (10-16') from the ground and aimed to record activity within an opening in the forest canopy.

The Radar Tree Detector was positioned approximately 15' high in a sugar maple immediately over a fringe of high shrub vegetation (Photo 3-1). The tree itself was situated along the edge of a narrow woods road, adjacent to a former log landing that contained the met tower and radar location site. The detector microphone was targeted along the road edge and down along a relatively narrow (8-10') road corridor bordered by high deciduous saplings and trees. Vegetation along the road corridor edges and adjacent radar site clearing was irregular and varied from 20 to 30 feet in height with numerous gaps. Vegetation within the adjacent clearing was dominated by thick maple coppice sprouts and Rubus spp., and generally varying from 3 to 5 feet in height.

Photo 3-1. Radar tree detector.

The North Tree Detector was positioned approximately 16' high in a dead, balsam fir snag, situated at the edge of a clump of mixed trees within a large, clearcut opening (Photo 3-2). The opening was largely dominated by high grasses and mixed herbaceous vegetation and included clearings associated with a road crossings. Vegetation surrounding the clearing was largely dead and pole sized spruce and fir, with scattered birch and mixed hardwoods.

Photo 3-2. North tree detector.

The Road Tree Detector was positioned approximately 13' high in a paper birch pole over a *narrow band of red spruce and birch high saplings at the edge of a former woods road landing* site (Photo 3-3). The detector was located approximately mid-height of the local canopy; other tree and high pole vegetation around the clearing generally varied from 25 to 35 feet in height and was composed almost exclusively of deciduous, northern hardwoods. The adjacent clearing was approximately 0.3 acres in size and open, with only low herbaceous and grass species. The tree edge microphone was pointed directly into the clearing.

Photo 3-3. Road tree detector.

3.2.2 Data Analysis

Potential call files were extracted from data files using CFCread© software. The default settings for CFCread© were used during this file extraction process, as these settings are recommended for the calls that are characteristic of northeastern bats. This software screens all data recorded by the bat detector and extracts call files using a filter. Using the default settings for this initial screen also ensures comparability between data sets. Settings used by the filter include a max TBC (*time between calls) of 5 seconds, a minimum line length of 5 milliseconds, and a* smoothing factor of 50. The smoothing factor refers to whether or not adjacent pixels can be connected with a smooth line. The higher the smoothing factor, the less restrictive the filter is and the more noise files and poor quality call sequences are retained within the data set. A call is a single pulse of sound produced by a bat. A call sequence is a combination of two or more pulses recorded in a call file. Understanding the parameters of these settings is important in terms of determining when individual calls are classified as "unknown".

Following extraction of call files, each file was visually inspected to ensure that files created by static or some other form of interference that were still within the frequency range of Maine bats were not included in the data set. Bat calls typically include a series of pulses characteristic of normal flight or prey location ("search phase" calls) and capture periods (feeding "buzzes") and visually look very different than static, which typically forms a diffuse band of dots at either a constant frequency or widely varying frequency, caused by wind, vibration, or other interference. Using these characteristics, bat call files are easily distinguished from non-bat files.

Bat call sequences were individually marked and categorized by species group, or "guild" based on visual comparison to reference calls. Qualitative visual comparison of recorded call sequences of sufficient length to reference libraries of bat calls allows for relatively accurate identification of bat species (O'Farrell *et al.* 1999, O'Farrell and Gannon 1999). A call sequence was considered of suitable quality and duration if the individual call pulses were "clean" (i.e., consisting of sharp, distinct lines) and at least five pulses were included within the sequence. Call sequences were classified to species whenever possible, based on criteria developed from review of reference calls collected by Chris Corben, the developer of the Anabat system, and other bat researchers. However, due to similarity of call signatures between several species, all *classified calls have been categorized into guilds*[3] *reflecting the bat community in the region of* the Project area and is as follows:

- **Unknown (UNKN)** – All call sequences with too few pulses (less than five) or of poor quality (such as indistinct pulse characteristics or background static). These calls were further identified as either "high frequency unknown" (HFUN) for calls above 30kHz or "low frequency unknown" (LFUN) for calls below 30kHz;

- **Myotid (MYSP)** – All bats of the genus *Myotis*. While there are some general characteristics believed to be distinctive for several of the species in this genus, these

[3] Gannon *et al.* 2003 categorized bats into guilds based upon similar minimum frequency and call shape. These guilds were: Unidentified, Myotis, LABO-PISU and EPFU-LANO-LACI.

characteristics do not occur consistently enough for any one species to be relied upon at all times when using Anabat recordings;

- **Red bat/pipistrelle (RBEP)** – Eastern red bats and eastern pipistrelles. These two species can produce calls distinctive only to each species. However, significant overlap in the call pulse shape, frequency range, and slope can also occur; and;

- **Big brown/silver-haired/hoary bat (BBSHHB)** – This guild will be referred to as the big brown guild. These species' call signatures commonly overlap and have therefore been included as one guild in this report.

This guild grouping represents the most conservative approach to bat call identification (Hayes 2000). Since some species do sometimes produce calls unique only to that species, all calls were identified to the lowest possible taxonomic level before being grouped into the listed guilds. Tables and figures in the body of this report will reflect those guilds. However, since species-specific identification did occur in some cases, each guild will also be briefly discussed with respect to potential species composition of recorded call sequences.

Once all of the call files were identified and categorized in appropriate guilds, nightly tallies of detected calls were compiled. Mean detection rates (number of calls/detector-night) for the entire sampling period were calculated for each detector and for all detectors combined. It is important to note that detection rates indicate only the number of calls detected and do not necessarily reflect the number of individual bats in an area. For example, a single individual can produce one or many call files recorded by the bat detector, but the bat detector cannot differentiate between individuals of the same species producing those calls. Consequently, detections recorded by the bat detector system likely over-represent the actual number of animals that produced the recorded calls.

3.2.3 Radar, Ceilometer, and Night-vision Goggle Observations

Ceilometer surveys were also conducted concurrently with the acoustic bat monitoring on 20 nights during the spring sampling period. In addition, use of night-vision goggles, combined with red filtered flood lights, provided an excellent opportunity to view the air space immediately around the radar location. The experimental use of the goggles was introduced midway during the survey period, but once available, were used on an hourly basis much as the ceilometer surveys. While conclusive differentiation between bats and birds is not possible using radar, work conducted by Stantec during previous studies using radar, night-vision goggles, and thermal imaging cameras indicates that nocturnal targets that move erratically or in curving paths are typically bats, while those with straight flight paths are birds. Additionally, while bats can create radar flight paths more similar to birds (i.e., straight flight path), no birds were observed creating the erratic radar flight paths observed to be created by some bats (Woodlot, unpublished observations)[4].

Targets with erratic flight paths, similar to those previously observed to be created by bats were noted during the analysis of the radar video data. Nightly tallies of these targets were then made. Additionally, the night-vision goggle observations made during the radar survey were an opportunity to document birds and bats flying at low altitude over the radar site and to better distinguish birds and bats from moths and other large flying insects. Any bats observed during the night-vision surveys were recorded.

3.2.4 Weather Data

Weather data was collected from an anemometer on the met tower at the summit of Sam Drew Mountain between April 25 and August 11. Additional data was also collected from a weather station deployed by Stantec at the radar site during the spring survey period. For reporting purposes, wind direction and wind speed was recorded by the anemometer. Temperature and humidity was recorded by data loggers (HOBO Pro v2 U23-001, Onset Computer Corporation). The mean wind direction, wind speed, temperature, and humidity were calculated for each night.

3.3 RESULTS

3.3.1 Detector Call Analysis

For the spring survey, six detectors were deployed April 25 and continued to record data through May 31, for a total survey period of 37 nights. For the summer survey, six detectors recorded data from June 1 through August 11 for a total summer survey period of 72 nights. The range of dates that each detector was deployed is summarized in Table 3-1 and Table 3-2. Occasional data gaps occurred when detectors powered down during the survey period. Although the North Tree detector functioned normally in the spring, a computer hardware malfunction precluded successful data downloads from this detector. To account for these periods, the number of detector-nights is reported for each detector. Combined, the six detectors at Oakfield sampled a total of 158 detector-nights during the spring survey period and a total of 407 detector-nights during the summer survey period.

During the spring, a total of 600 bat call sequences were recorded (Table 3-1). Excluding the North Tree detector, the number of call sequences recorded by each detector ranged from 3 at the Radar High detector to 261 at the South Tree detector. The overall mean detection rate for all six detectors was 3.8 calls/detector-night. Detection rates at each of the tree detectors ranged from 3.4 calls/detector-night at the Road Tree detector to 9.1 calls/detector-night at the Radar Tree detector, for an overall mean detection rate among the tree detectors of 6.8 calls/detector-night. The maximum number of call sequences recorded in one night ranged

[4] All field work and any reporting and permitting activities performed prior to October 1, 2007, were conducted as Woodlot Alternatives, Inc. and will be herein referenced as work done by Woodlot. Stantec Consulting Services, Inc. formally merged with Woodlot Alternatives, Inc. on October 1, 2007. Work conducted on or after October 1, 2007 is herein referenced as work done by Stantec.

from 24 at the Road Tree detector to 60 at the Radar Tree detector. No calls were recorded by the Radar High detector after May 16.

Table 3-1. Summary of bat detector field survey effort and results - Spring 2008.

Location	Dates	# Nights	# Detector-Nights*	# Recorded sequences	Detection Rate **	Maximum # calls recorded ***
Radar Met High	4/25-5/31	37	36	3	0.1	2
Radar Met Low	4/25-5/31	37	36	13	0.4	2
Radar Tree	4/25-5/31	37	24	218	9.1	60
North Tree	4/28-5/29	33	0	0	0.0	0
South Tree	5/1-5/31	31	31	261	8.4	58
Road Tree	5/1-5/31	31	31	105	3.4	24
	Overall Results Met	***74***	***72***	***16***	***0.2***	--
	Overall Results Tree	***132***	***86***	***584***	***6.8***	--
Overall Results Combined		***206***	***158***	***600***	***3.8***	

* Detector-night is a sampling unit during which a single detector is deployed overnight. On nights when two detectors are deployed, the sampling effort equals two detector-nights, etc.

** Number of bat passes recorded per detector-night.

*** Maximum number of bat passes recorded from any **single** detector for a 12-hour sampling period.

During the summer, a total of 6013 bat call sequences were recorded (Table 3-2). The number of call sequences recorded by each detector ranged from 3 (North Met High) to 4452 (Radar Tree). The overall mean detection rate for all six detectors in nine locations was 15.0.

Detection rates at each of the four tree detector locations ranged from 2.0 calls/detector night at the North Tree detector to 61.8 calls/detector-night at the Radar Tree detector, for an overall mean detection rate among the tree detectors of 30.5 calls/detector night. The maximum number of call sequences recorded in one night ranged from 21 at North Tree detector to the 693 at the Radar Tree detector.

Detection rates at each of the five met tower detector locations ranged from 0.1 calls/detector night at the North Met High detector to 1.8 calls/detector night at the Radar Met Low detector, for an overall mean detection rate among met tower detectors of 1.1 calls/detector night. The maximum number of call sequences recorded in one night ranged from 1 at the North Met High detector to 32 at the Radar Met High detector.

Table 3-2. Summary of bat detector field survey effort and results - Summer 2008.

Location	Dates	# Nights	# Detector-Nights*	# Recorded sequences	Detection Rate **	Maximum # calls recorded ***
Radar Met High	6/1-8/11	72	47	68	1.4	32
Radar Met Low	6/1-8/11	72	72	129	1.8	19
Radar Tree	6/1-8/11	72	72	4452	61.8	693
North Tree	6/1-7/10	40	40	79	2.0	21
South Tree	6/1-7/10	40	40	1164	29.1	277
Road Tree	6/1-7/10	40	40	166	4.2	25
North Met High	7/11-8/11	32	32	3	0.1	1
North Met Low	7/11-8/11	32	32	9	0.3	2
South Met High	7/11-8/11	32	32	33	1.0	18
Overall Results Met		***240***	***215***	***242***	***1.1***	--
Overall Results Tree		***192***	***192***	***5861***	***30.5***	--
Overall Results Combined		***432***	***407***	***6103***	***15.0***	--

* *Detector-night is a sampling unit during which a single detector is deployed overnight. On nights when two detectors are deployed, the sampling effort equals two detector-nights, etc.*

** Number of bat passes recorded per detector-night.

*** Maximum number of bat passes recorded from any **single** detector for a 12-hour sampling period.

Overall, peak numbers of call sequences were primarily recorded in mid June for the met tower detectors (Figure 3-1) and early July for the tree detectors (Figure 3-2). All four tree detectors recorded peak levels of activity during early July, although smaller peaks were also recorded at other times. The Radar Tree detector recorded peak levels of calls during the first two weeks of July, with a smaller peak in mid-June; peaks were typically more than 200 calls per night. The South Tree detector also recorded a peak in early July, with smaller peaks in mid-June, with two nights of approximately 80 calls. Peaks for the Road Tree detector were recorded during mid-May, mid-June, and early July although no nights recorded more than 25 calls.

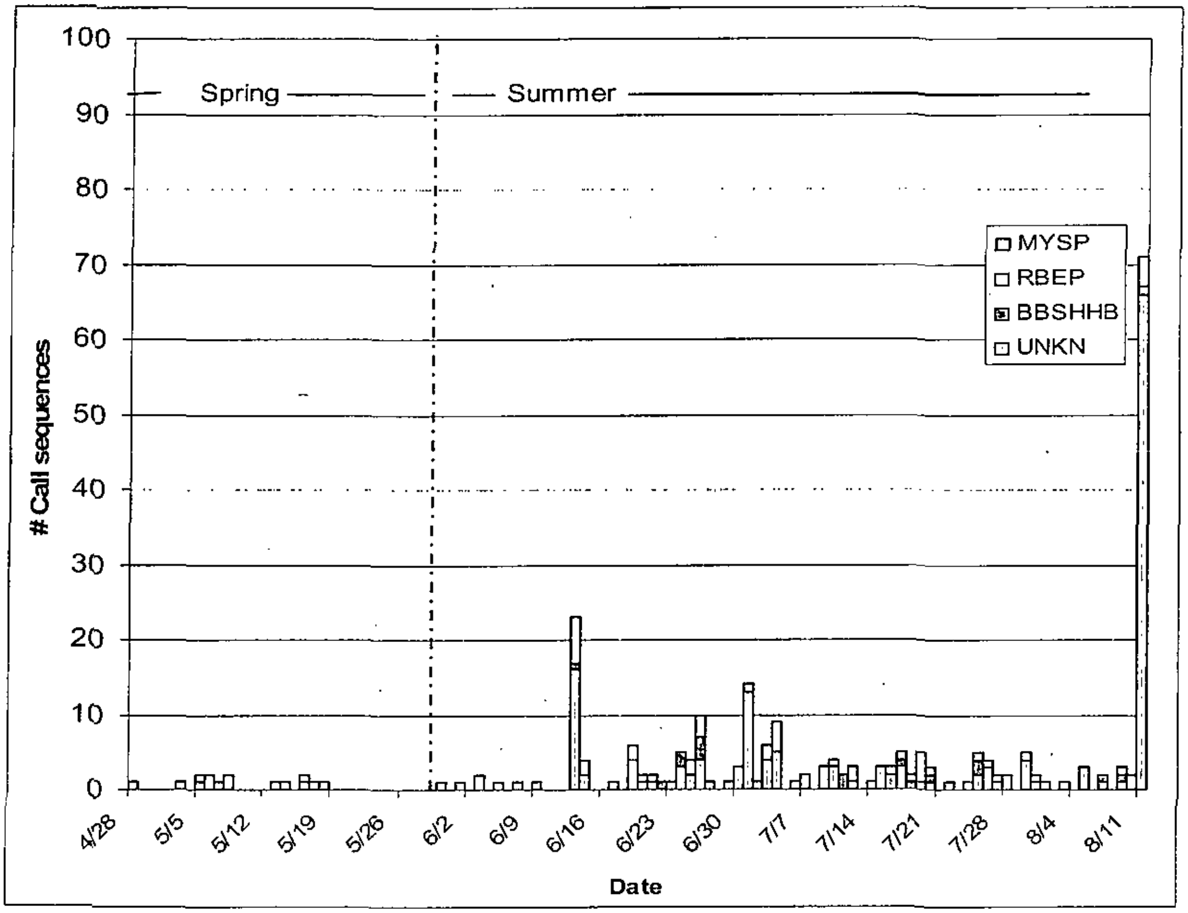


Figure 3-1. Guild composition of total nightly bat call sequence detections (n = 258) recorded at met tower detectors during the spring and summer 2008 survey periods.

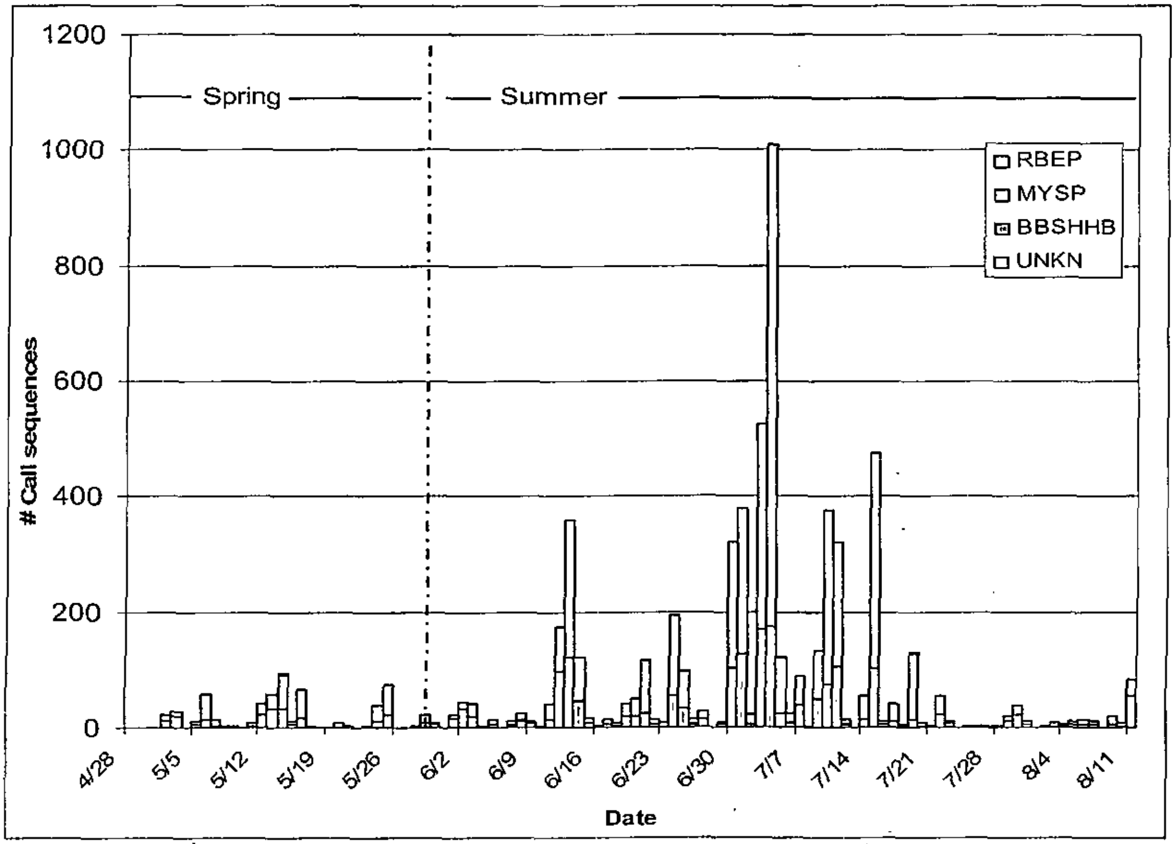


Figure 3-2. Guild composition of total nightly bat call sequence detections (n = 6445) recorded at tree detectors during the spring and summer 2008 survey periods.

Calls from the MYSP and UNKN guilds were primarily responsible for the peaks in call volume throughout both seasons.

In the spring, some of the recorded call sequences (38%) were labeled as unknown due to very short call sequences (less than five pulses) or poor call signature formation (probably due to a bat flying at the edge of the detection zone of the detector or flying away from the microphone; Table 3-3). Of the calls that were identified to species or guild, those of the MYSP guild were the most common (62% of all call sequences), followed by the species within the RBEP guild (0.3% of all call sequences) and the BBSHHB guild (0.2%). Of the calls recorded at each detector identified to guild, those of the MYSP guild were the most common, and in most cases made up more than 40 percent of all calls. At each detector, calls within the UNKN group made up approximately one quarter to half of all calls recorded.

Table 3-3. Summary of the composition of recorded bat call sequences - Spring 2008.					
Detector	**Guild**				**Total**
	Big brown guild	**Red bat/ E. pipistrelle**	**Myotis**	**Unknown**	
Radar Met High	0	0	0	3	3
Radar Met Low	0	0	8	5	13
Radar Tree	0	0	166	52	218
North Tree	0	0	0	0	0
South Tree	0	2	146	113	261
Road Tree	1	0	52	52	105
Overall Results Met	***0***	***0***	***8***	***8***	***16***
Overall Results Tree	***1***	***2***	***364***	***217***	***584***
Grand Total	***1***	***2***	***372***	***225***	***600***
Species composition (%)	***<1%***	***<1%***	***62%***	***38%***	

In the summer, some of the recorded call sequences (32%) were labeled as unknown due to very short call sequences (less than five pulses) or poor call signature formation (probably due to a bat flying at the edge of the detection zone of the detector or flying away from the microphone; Table 3-3). Of the calls that were identified to species or guild, those of the MYSP guild were the most common (68% of all call sequences), followed by the species within the RBEP guild (0.4% of all call sequences) and the BBSHHB guild (0.1%). Of the calls recorded at each detector identified to guild, those of the MYSP guild were the most common and comprised 40 to 80 percent of all calls.

Table 3-4. Summary of the composition of recorded bat call sequences - Summer 2008.

Detector	**Guild**				***Total***
	Big brown guild	**Red bat/ E. pipistrelle**	**Myotis**	**Unknown**	
Radar Met High	5	0	12	51	68
Radar Met Low	4	1	38	86	129
Radar Tree	1	3	3,000	1448	4,452
North Tree	3	0	36	40	79
South Tree	3	0	962	199	1,164
Road Tree	2	0	71	93	166
North Met High	0	0	0	3	3
North Met Low	3	1	1	4	9
South Met High	4	1	2	26	33
Overall Results Met	**16**	**3**	**53**	**170**	**242**
Overall Results Tree	**9**	**3**	**4069**	**1780**	**5861**
Grand Total	***25***	***6***	***4122***	***1950***	***6103***
Species composition (%)	**0%**	**0%**	**68%**	**32%**	**100%**

In the spring, overall nightly activity showed a peak between 8:00 pm and 9:00 pm (20:00 and 21:00; Figure 3-3). Peaks in overall activity were relatively consistent at an individual detector level, but with some relatively minor fluctuations of hourly peak use between the various detectors.

In the summer, overall nightly activity showed a peak between 1:00 am and 2:00 am (Figure 3-4) and no calls were recorded after 4:00 am.

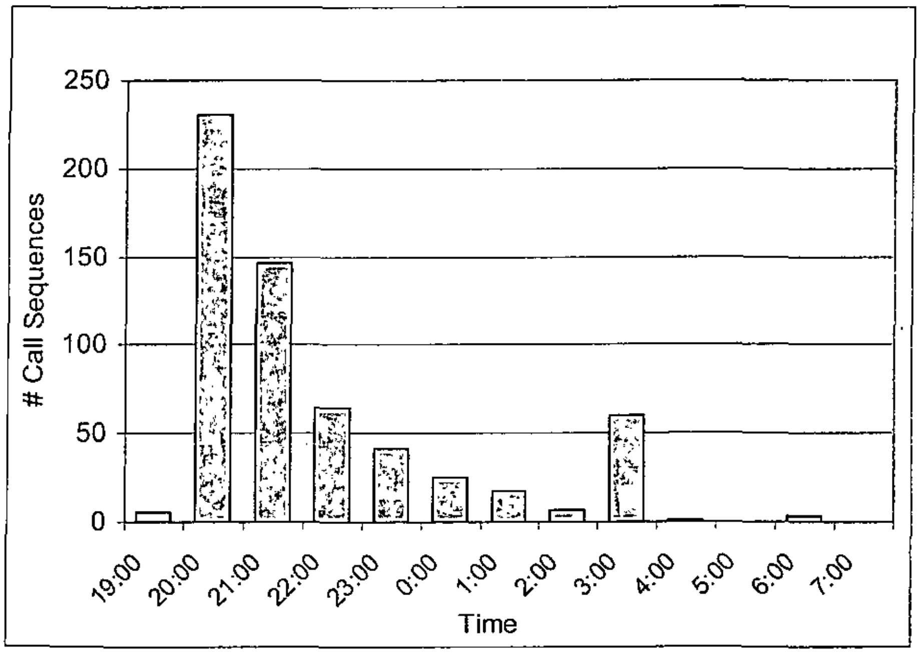


Figure 3-3. Nightly timing of recorded bat activity for all detectors deployed during spring 2008.

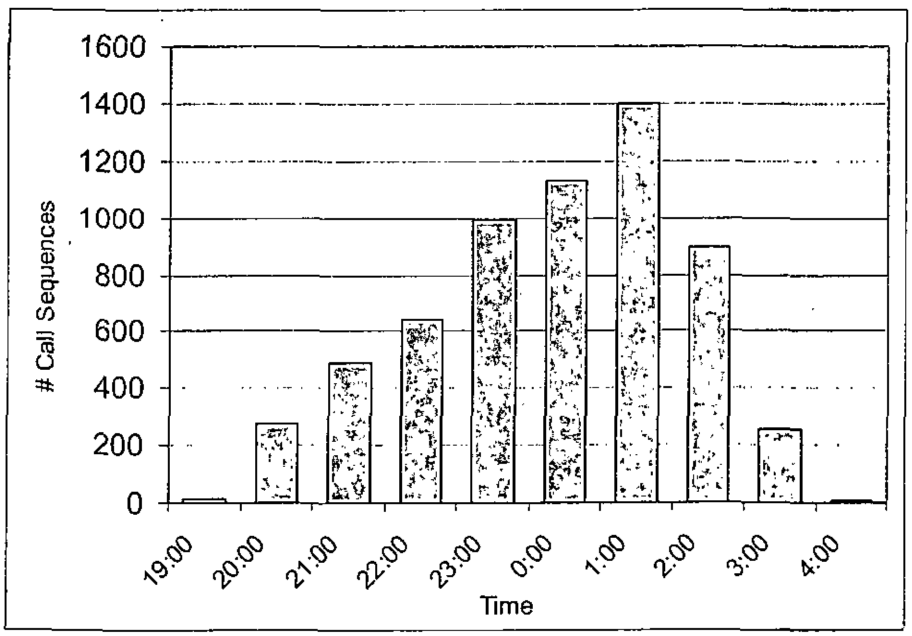


Figure 3-4. Nightly timing of recorded bat activity for all detectors deployed during summer 2008.

Appendix B provides a series of tables with more specific information on number of call sequences, by guild and suspected species, recorded at each detector and the weather conditions for that night. The actual data file information for each of the detectors and all recorded call sequences can be provided upon request.

3.3.2 Radar, Ceilometer and Night-vision Goggle Observations

During radar surveys conducted in the spring period, 65 bats were observed during the course of 54 five-minute ceilometer observation periods. During analysis of the radar survey video data, 0.1% of target trails were identified as potential bats (Appendix A, Table 5). These observations were generally distributed throughout the sampling period. No correlations between the total number of recorded bat call sequences and ceilometer, radar target, or radar passage rates were observed. The use of night vision goggles enabled more qualitative observations but these were not quantified due to the late season start.

3.3.3 Weather Data

In the spring (April 25 to May 31), mean nightly wind speeds in the Project area varied between 2.4 and 11.3 meters per second (m/s), with an overall mean of 7.5 m/s (Figure 3-5). Mean nightly temperatures varied between -2.3°C and 11.4°C, with an overall mean of 6.3°C (Figure 3-6). Bat call activity at each detector did not correlate strongly with temperature, wind speed or relative humidity.

In the summer (June 1 to August 11), mean nightly wind speeds varied between 2.4 and 11.9 m/s, with an overall mean of 6.6 m/s (Figure 3-7). Mean nightly temperatures varied between 8.0°C and 21.6°C, with an overall mean of 14.9°C (Figure 3-8). Bat call activity at each detector did not correlate strongly with temperature, wind speed or relative humidity.

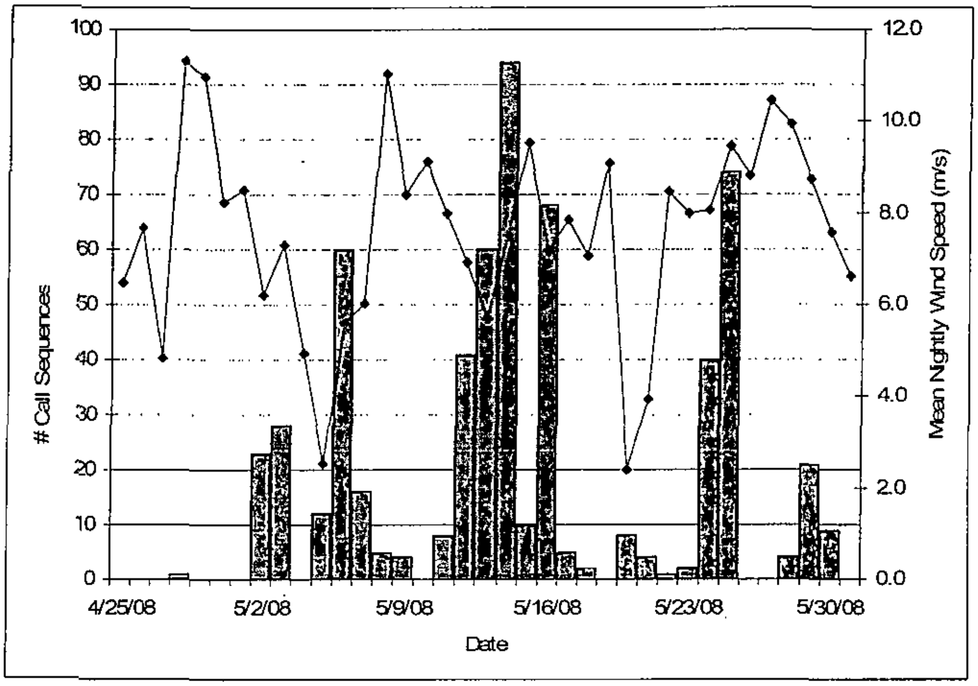


Figure 3-5. Nightly mean wind speed (m/s) (blue line) and bat call detections in spring 2008

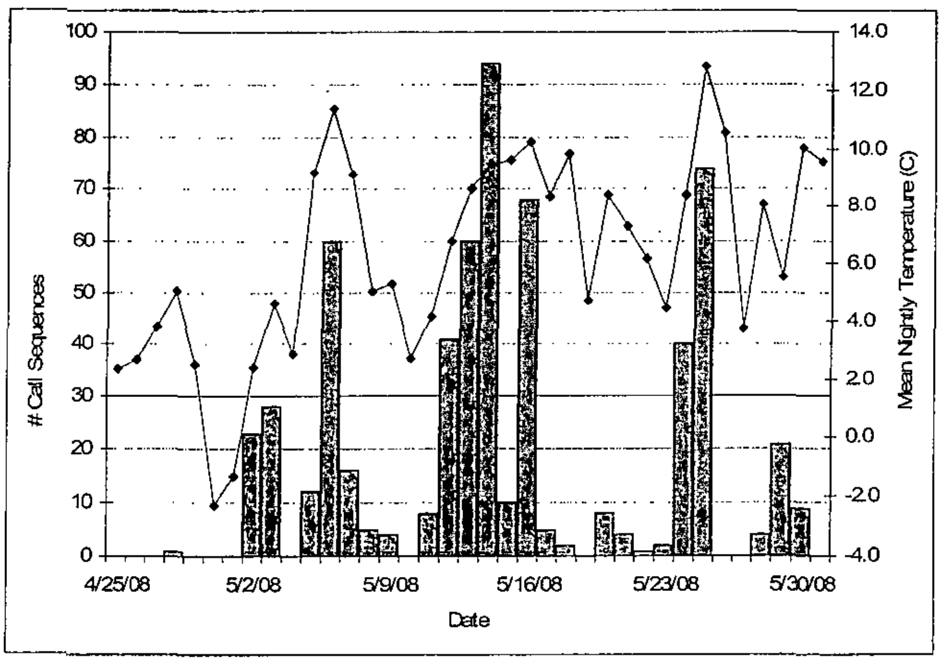


Figure 3-6. Nightly mean temperature (Celsius) (blue line) and bat detections in spring 2008

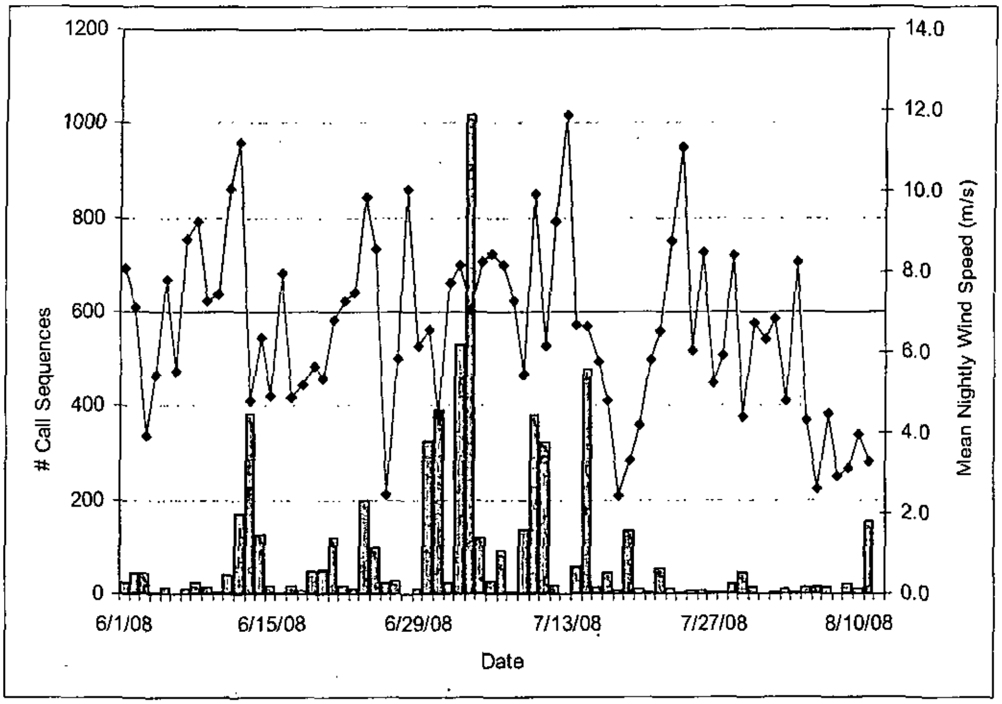


Figure 3-7. Nightly mean wind speed (m/s) (blue line) and bat call detections in summer 2008

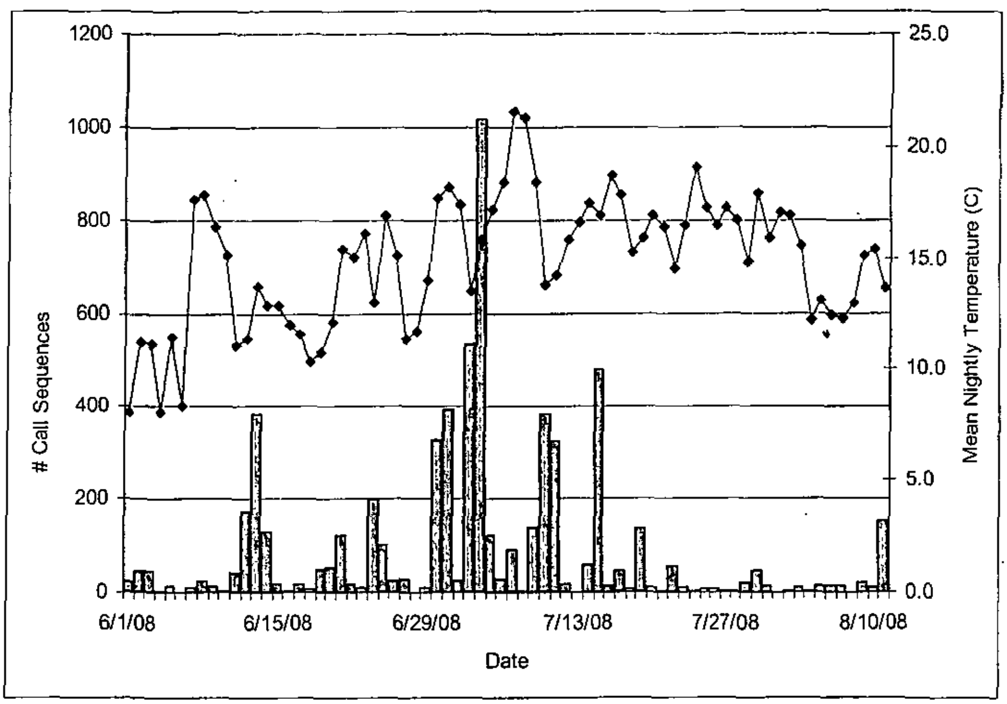


Figure 3-8. Nightly mean temperature (Celsius) (blue line) and bat detections in summer 2008

3.4 DISCUSSION

Bat echolocation surveys in spring and summer 2008 provide some insight into activity patterns, possible species composition, and timing of movements of bats in the Project area. Bat activity was variable among nights at all nine acoustic sampling locations. Peak call sequence detections occurred during early July with isolated peaks during mid-May and mid-June, and did not appear to correlate with temperature, relative humidity or wind speed. Overall nightly activity peaked at 8:00 pm in the spring and 2:00 am in the summer. The most common call sequences recorded were those of the MYSP and UNKN guilds. The overall mean detection rate during the spring survey period was 3.8 calls/detector-night. This rate is within range of other spring bat detector surveys conducted recently within the area (Appendix C Table 14).

In both seasons, the Radar Tree and South Tree detectors recorded the majority of calls in the Project area. In the summer, the Radar Tree detector recorded 73 percent of all calls, and 62 percent of the calls at this detector were recorded during the first two weeks of July. Additionally, all but two of the calls during those two weeks were of the genus Myotis or were high-frequency unknown (which are more likely to be of the genus Myotis). Myotis are known to typically forage at lower heights and are thought to use man-made and natural openings below the forest canopy for travel or foraging. Because these bat detectors were located in potential travel corridors used for foraging, it is possible that numerous call sequences could be from the same individual bat or group of bats traveling or foraging along the trails (Arnett et al. 2006). These activity patterns likely account for the higher detection rate at these detectors. Detector placement with regards to height and clutter[5] may also influence the number of detections at a detector (Weller and Zabel 2002). The potential influences of detector location, orientation and height were not teased apart in this survey.

Bat calls were identified to guild within this report, although calls were provisionally categorized by species when possible during analysis. Certain species, such as the eastern red bat and hoary bat have easily identifiable calls, whereas other species, such as the big brown bat and silver-haired bat are difficult to distinguish acoustically. Similarly, certain members of the genus *Myotis*, such as the little brown bat are far more common and have slightly more distinguishable calls than other species. The following paragraphs discuss each guild separately and address likely species composition of recorded bats within each guild.

The MYSP guild includes all three species of *Myotis* potentially occurring in the Project area, including the little brown bat, northern long-eared bat, and the eastern small-footed bat. Of these species, the little brown bat and northern long-eared bat are by far the most common, and have calls that tend to be slightly more distinguishable using the Anabat system. *Myotis* species were most common at this site overall and were recorded by every detector except the North

[5] Here clutter is defined as obstacles in the environment such as understory vegetation or tree trunks which may obscure or block ultrasonic signals between a bat and the microphone of the bat detector (Weller and Zabel 2002).

Met High detector. Calls were not diagnostic of any of the three *Myotis* species. Most calls were of weak signal strength.

The RBEP guild includes the eastern pipistrelle and eastern red bat. Eastern red bats have relatively unique calls which span a wide frequency range and have a characteristic hooked shape and variable minimum frequency. Eastern pipistrelles tend to have relatively uniform calls, with a constant minimum frequency and a sharply curved profile. Of the eight sequences classified as RBEP, both were likely eastern red bat sequences as eastern pipistrelles tend to be solitary foragers, often feeding over water and emerging around sunset. Conversely, eastern red bats will occasionally forage in groups of 20-30 individuals (DeGraaf and Yamasaki 2001) and typically emerge 1-2 hours after sunset, though they may forage throughout the night (Kunz 1973). The eastern red bat sequences were recorded at two tree detectors (Radar Tree and South Tree) and at three met detectors (Radar Met low, North Met Low, South Met). Eastern red bats tend to use forested habitat adjacent to streams and open fields (Shump and Shump 1982).

The BBSHHB guild includes the big brown bat, silver-haired bat, and hoary bat. Within this grouping, the hoary bat has easily distinguishable calls characterized by highly variable minimum frequencies often extending below 20 kHz, and a hooked profile similar to the eastern red bat. Calls of silver-haired bats and big brown bats are occasionally distinguishable, but often overlap in range and difficult to distinguish, especially when comparing short duration calls typical of those recorded during passive monitoring. In the spring, a single call sequence was classified as BBSHHB; the sequence was likely a big brown bat or silver-haired bat but was not diagnostic of either species. In the summer, 25 call sequences were classified as BBSHHB; thirteen of which were likely a big brown bat or silver-haired bat but were not diagnostic of either species. There were three call sequences identified as big-brown bat, four sequences identified as silver-haired bat, and six sequences identified as hoary bat. Both big brown and silver-haired bats forage in forested habitats (Kunz 1982, Kurta and Baker 1990).

Of all call sequences recorded at Oakfield in both seasons, 32 percent were classified as UNKN, due to their short duration or poor quality. However, these calls were identified as "high frequency" or "low frequency". For the purposes of this analysis, "high frequency" call fragments were defined as having a minimum frequency above 30 kHz, and "low frequency" calls were defined as having a minimum frequency below 30 kHz. Nearly all call sequences classified as UNKN were high frequency (97 percent). Many of the high frequency unknown calls at the Radar Tree detector were likely *Myotis* species.

Differences in detection rates between guilds at the various detectors deployed in the Project area may reflect varying vertical distribution and habitat preferences of bat species (Hayes 2000). Recent research (Arnett 2006) found that small *Myotis* species were more frequently recorded at lower heights, while larger species were typically recorded more often at higher heights. This is generally consistent with observations at Oakfield during both spring and summer 2008.

Ongoing mortality studies and acoustic surveys indicate bat activity patterns during migration are responsive to weather conditions. Acoustic surveys have documented a decrease in bat activity rates as wind speed increases and temperatures decrease, and bat activity has been shown to correlate negatively with low nightly mean temperatures (Hayes 1997, Reynolds 2006). Similarly, weather factors appeared related to bat collision mortality rates documented at two facilities in the southeastern United States, with mortality rates negatively correlated with both wind speed and relative humidity, and positively correlated to barometric pressure (Arnett 2005). These patterns suggest that bats are more likely to migrate on nights with low wind speeds (less than 4-6 m/s) and generally favorable weather (warm temperatures, low humidity, high barometric pressure). At Oakfield, bat activity did not correlate strongly with weather conditions. This may be a function of the higher number of tree detectors, which are within the canopy and therefore more sheltered, relative to the met tower detectors.

Bat activity also appeared to vary by time of night. In the spring, a peak in activity occurred soon after dusk and a small peak occurring before dawn. The pre-dawn peak is mainly accounted for by activity at the South Tree detector, however. In the summer, peaks varied by detector but were typically between 11:00 pm and 2:00 am. Patterns of bat activity within nights can vary, and anywhere from one to several peaks of activity have been documented. This bimodal nighttime distribution of bat activity seems to be a consistent behavioral trend in a number of species (Hayes 1997). Anthony *et al.* (1981) documented that bats appear to leave roosting sites at dusk to forage for a given period, return to their roosts during the middle portion of the night, then forage again later in the evening, closer to dawn.

Results of acoustic surveys must be interpreted with caution. Considerable room for error exists in identification of bats based upon acoustic calls alone, especially if a site or regionally specific library of recorded reference calls is not available. Also, detection rates are not necessarily correlated with the actual numbers of bats in an area, because it is not possible to differentiate between individual bats (Hayes 2000). Stantec can provide a digital file of all acoustic calls, including all information about species identification and timing of calls from each detector on an hourly and nightly basis, should that information be desired.

3.5 CONCLUSIONS

Detector surveys conducted during the spring and summer 2008 migration period have provided information on bat activity in the vicinity of the Project area. Survey locations were representative of habitats in the Project area and included detectors at heights near the rotor zone. The surveys documented species that would be expected in the area based on the species' range and abundance, as well as the habitat types present in the Project area.

Bat activity during spring and summer at Oakfield during was similar to other ongoing regional studies. Although the levels of bat activity were variable throughout the spring and summer sampling period at each of the nine acoustic sampling locations, the species composition was consistent between detectors, with *Myotids* comprising the majority of call sequences in both seasons.

4.0 Diurnal Raptor Surveys

4.1 INTRODUCTION

The Project is located in the Laurentian Plains and Hills ecoregion of the "Eastern Continental Hawk Flyway[6]," which extends from the Canadian Maritimes south to eastern Florida. Within this large area, raptors tend to concentrate along linear ridges, which create updrafts or "thermals" that raptors can use to fly long distances with minimal exertion. Glacial processes from the Laurentian ice shelf recession shaped the entire ecoregion, creating numerous lakes and wetland areas and carving out the gradual western slopes and steep eastern slopes of the Project area. The ridgeline on Sam Drew and Timoney Mountains are arranged in northeast to southwest linear fashion. Oakfield Hills is isolated from Sam Drew Mountain to the south by a saddle, but both share topographical similarities in the eastern and western slopes. The Project ranges in elevations from approximately 393 m (1290') at the Peak of Sam Drew Mountain to approximately 162 m (530') at the East Branch of the Mattawamkeag River (Figure 1-1).

Stantec designed and conducted diurnal raptor surveys to identify potential popular migration corridors and document species specific flight and behavioral patterns near the Project area in accordance with recent and on-going seasonal raptor studies approved by U.S. Fish and Wildlife Service (USFWS) and Maine Department of Inland Fisheries and Wildlife (MDIFW).

4.2 METHODS

4.2.1 Field Surveys

Raptor surveys were conducted from the radar tower next to the met tower at the summit of Sam Drew Mountain (Figure 1-1). The radar tower afforded views to the south, east and west. Views down into the valley to the northwest were obstructed due to the nature of the gradually sloping terrain and vegetation. However, the observer was able to see over the tops of surrounding trees to account for raptors flying at eye level or higher over the northwestern valley.

Raptor surveys were conducted for twelve days from late April to late May and were generally performed on days with favorable flight conditions, which typically occur on days following the passage of weather fronts and low-pressure systems causing westerly winds. Surveys were based on Hawk Migration Association of North America (HMANA) methods (HMANA 2007). Surveys were conducted from 9 am to 4 pm, during the peak hours of thermal development and

[6] The Eastern Continental Flyway includes the Maritime Provinces; New England; New York (south and east of a line from Jamestown to Utica to the north end of Lake Champlain); Pennsylvania (all except Erie County); Mid-Atlantic States through Georgia, West Virginia, Kentucky and Tennessee; Florida east of a line from Lake Seminole south to Apalachicola (Kellogg 2007).

raptor movement. During surveys, observers scanned the sky and surrounding landscape for raptors with binoculars and a spotting scope. Observations were recorded onto HMANA data sheets, which summarize the data by hour. Hourly weather observations, including wind speed and direction, temperature, percent cloud cover, and precipitation were recorded. Information regarding the raptors' behavior and tendency to remain within the same location throughout the study period was noted in order to differentiate between migrating and resident birds. When possible, the general flight paths of observed individuals were plotted on topographic maps of the Project area.

Flight heights of birds were documented and categorized as less than, greater than, or equal to 120 m (394') above ground level (ground directly below the bird itself), which is the approximate height of the proposed wind turbines. Nearby objects with known heights, such as meteorological towers and nearby trees were used to gauge flight height.

Flight positions were categorized into 4 categories: A) flight path directly over Sam Drew (A1-parallel, or A2-perpendicular to Sam Drew, or A3-within valley saddle between Sam Drew and Oakfield Hills), B) flight path over upper slope portions of Sam Drew, C) flight path over lower slope of Sam Drew, and D) flight path not within Project area; Figure 4-1).

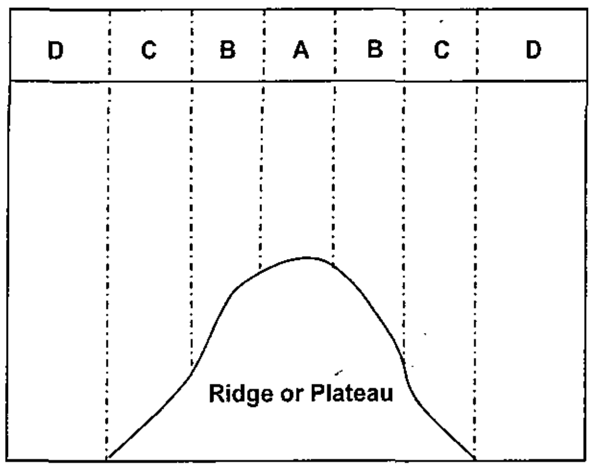


Figure 4-1. Flight position codes

Birds that flew too rapidly or were too far to accurately identify were recorded as unidentified to their genus or, if the identification of genus was not possible, unidentified raptor. Priority was given to raptor observations; however observers collected incidental data for other avian species observed including passerines and water birds.

4.2.2 Data Analysis

The raptor observation data was summarized by survey day and for the entire survey period. Analysis included a summary of:

- The total number of individuals per species observed for each survey day and for the entire survey period,
- The seasonal and daily observation rate (birds per hour). This was calculated for each survey day as well as for the entire spring survey period.
- The total number of individuals, by species, observed flying above or below 120 m (394') within the Project area; and
- The number of birds suspected to be resident based on their indirect flight paths and their tendency to occur in the Project area multiple times throughout the day.

The mapped flight paths and recorded flight positions were reviewed to identify any general flight patterns for migrant raptors in the vicinity of the Project area. In addition, minimum flight heights for individuals passing through each positional category were averaged.

Observations from the Project area were compared to 2008 data from local or regional HMANA hawk watch sites available on the HMANA web site or from HMANA yearly reports. Those HMANA watch sites used for comparison are from Bradbury Mountain in Maine, Barre Falls in Massachusetts, Shatterack Mountain in Massachusetts, Hawk Mountain in Pennsylvania and Allegheny Front in Pennsylvania. Although migration is likely to vary with topography, location, season, and weather, all HMANA sites used for comparison are within the Eastern Continental Hawk Flyway region. Also provided for comparison, are the results of available regional surveys conducted at other proposed wind farms mainly located in New York, Vermont, New Hampshire, and Maine.

4.3 RESULTS

Most surveys were conducted on clear days allowing for optimal visibility. Surveys were conducted from April 25 to May 30, resulting in a total of 12 survey days. Temperatures ranged from 3.3 to 25°C for the season. Winds speeds for the season ranged from calm (on April 20 and May 14) to 19.2 kilometers per hour (April 2). Observers detected 29 of 58 raptors on days with westerly winds, likely due to the updrafts created when wind collides with the western slope of Sam Drew Mountain. Raptors were observed 42 times between 9:00 am to 3:00 pm, an optimal time of day for thermals as the sun rises higher warming the earth's surface and mixing with nighttime air.

Surveys were conducted for a total of 79 hours during the 12 survey days. A total of 58 raptors representing 7 species was observed during that time (Figure 4-2), yielding an overall observation rate of 0.73 birds/hour. Daily count totals ranged from to 1 raptor on May 23 to 7 raptors on May 9, May 13 and May 14 (Figure 4-3; Appendix C, Table 1).

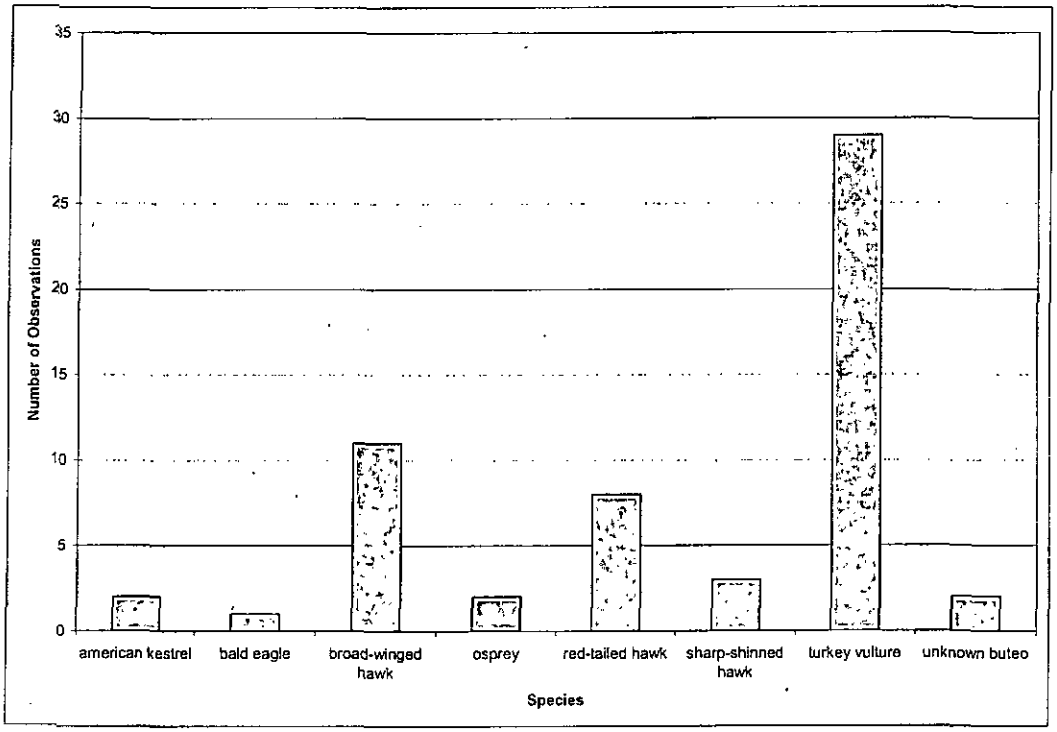


Figure 4-2. Species composition of raptors observed

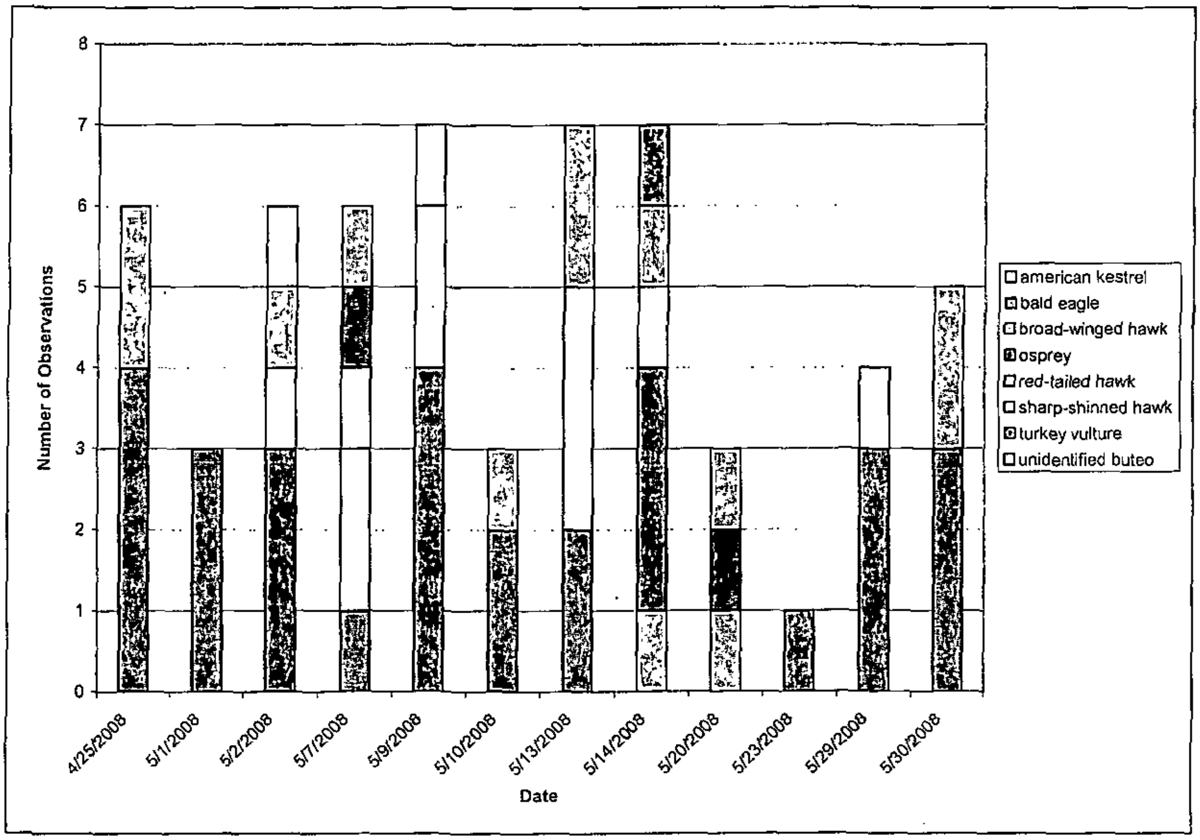


Figure 4-3. Daily species composition of raptors observed

Of the seven species observed flying over the Project area, a lone Bald eagle *(Haliaeetus leucocephalus)* was the only species observed that is state threatened in Maine. No other state of federally listed endangered or threatened species were observed.

In addition to varying ranges in daily counts due to seasonal variations, the timing of raptor observations varied during each survey day. The peak number of observations occurred between 11:00 am and 14:00 pm (Figure 4-4, Appendix C, Table 2). Observations made prior to 9:00 am were either resident or migrants utilizing stop over habitat near the Project area. This trend was generally consistent throughout the season, and likely mirrors patterns of thermal development above the ridgeline.

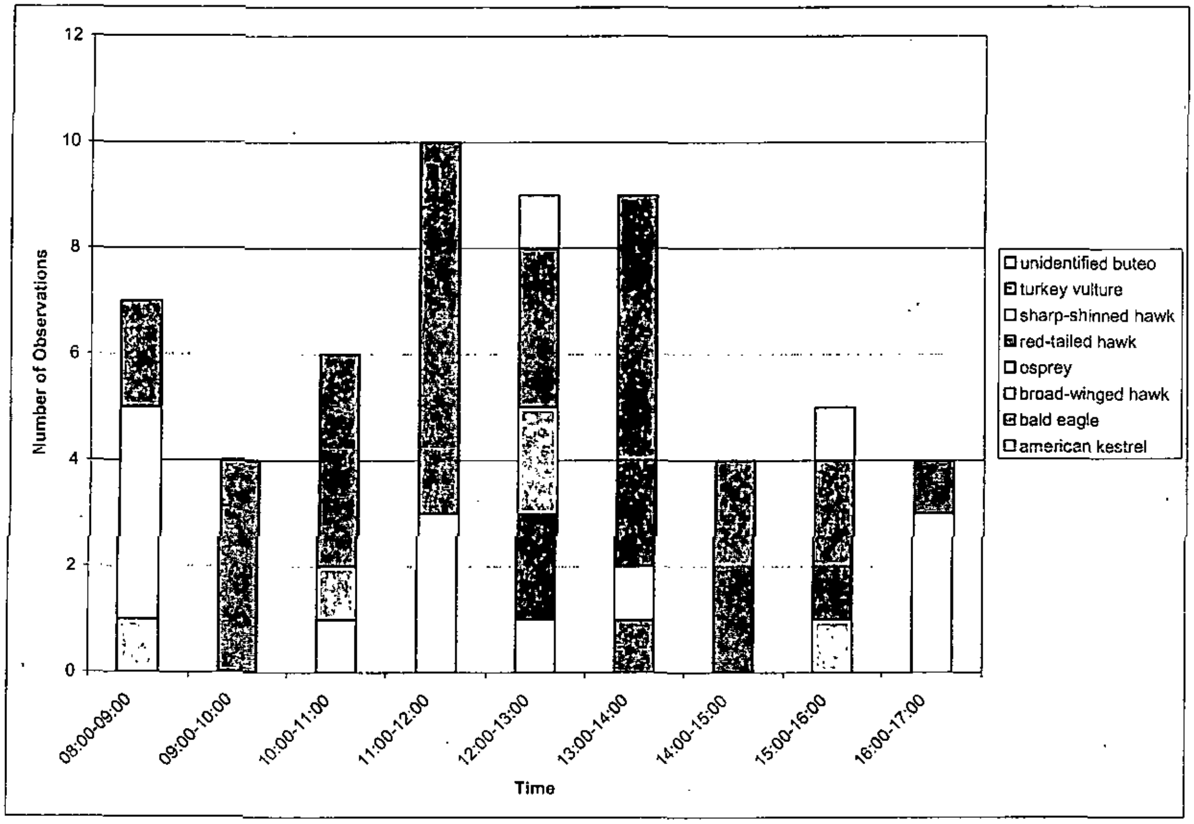


Figure 4-4. Hourly observation rates

As raptors traveled through or in the vicinity of the Project area, they often occurred in multiple flight positions (A-D) along the ridge or outside of the Project area[7]. Of the 77 recorded flight positions, forty percent (n=23) were observed flying directly over Sam Drew during some portion of their flight path (position A). Another forty percent (n=23) were observed flying along the upper slope or crest of the ridgeline (position B). Twenty-two percent (n=17) were observed flying along the lower slope (position C), and 18 percent (n=14) raptors were observed flying outside the Project area (position D). Of the 23 raptors flying directly above the ridgeline, 4 (17%) were observed flying along (or parallel to) the north/south linear ridgeline and 6 (20%) were observed flying perpendicularly over the ridgeline. No raptors were observed flying over the saddle between Sam Drew Mountain and Oakfield Hills.

For those birds observed flying within 1km of the observation, flight heights were categorized as below or above 120 m (394'), the approximate maximum height of the proposed turbines. Seventy-six percent of those raptors observed were flying less than 120 m above the ground for at least a portion of their flight through the Project area (Figure 4-5; Appendix C, Table 3);

[7] The result of which is a higher number of recorded flight positions (n=77) than individual bird observations (n=58).

however, only 32 percent (n=16) of raptor positions observed within 1 km were flying directly over the ridge (position A) at a flight under 120 m.

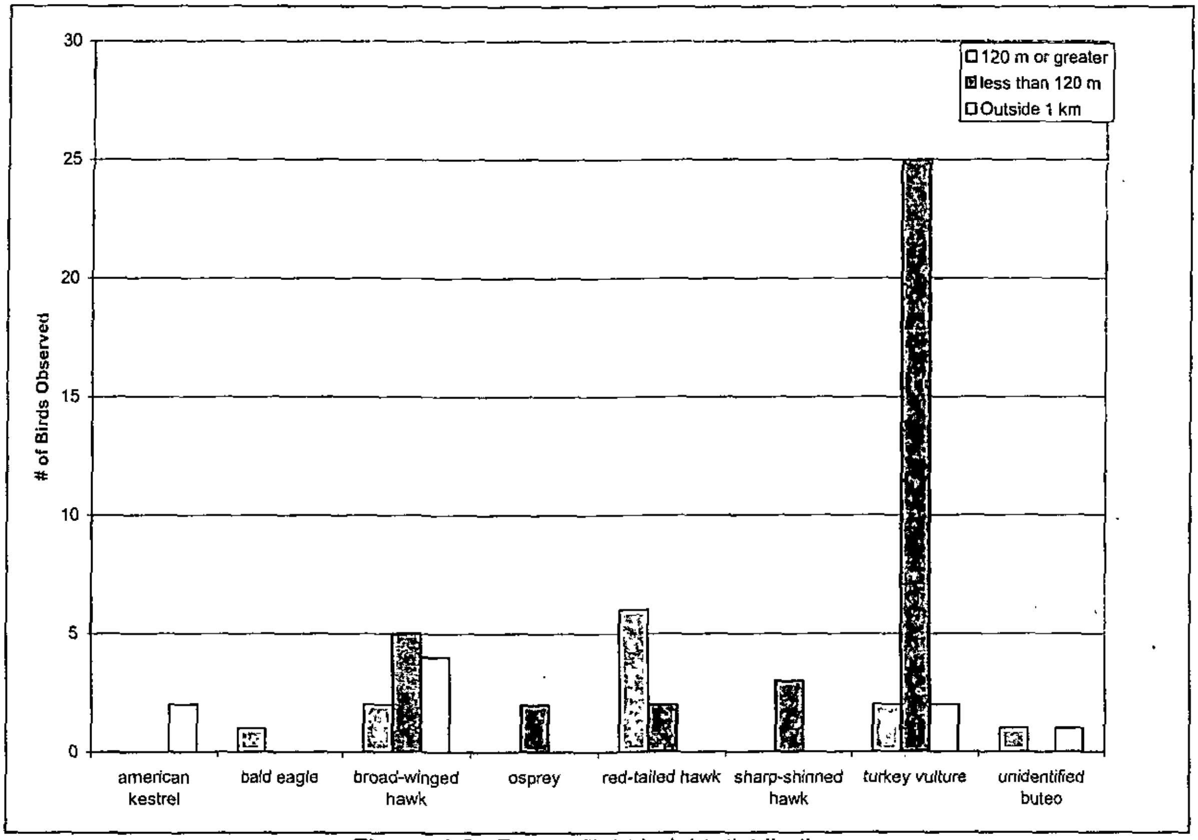


Figure 4-5. Raptor flight height distribution

The average of the minimum recorded flight height was calculated for observations of birds within each flight category: for the 23 observations in position A, the average minimum flight height was 90 m (295'); for the 23 birds in position B, the average minimum flight height was 54 m (178'); for the 17 birds in position C, the average minimum flight height was 107 m (351'); and for the 5 birds seen in position D, the average minimum flight height was 226 m (741').

4.4 DISCUSSION

A total of 58 raptors were observed during the 12 survey days during April 25 to May 30. A total of 9 species were recorded with an overall observation rate of 0.73 birds per hour. Turkey vultures were the most abundant species observed and comprised approximately 50 percent of all observations. Initial detection of a Bald eagle was over Meduxnekeag Lake on May 14. It was observed soaring high (350-400 m) and moving to the south over the valley and then along the slope of Hunt Ridge. There was one confirmed nest at Mednuxnekeag Lake as of 2006 and there are two other Bald eagle nests within 6.5 miles of the Oakfield Wind Project.

During the spring migration season, daily raptor counts at other sites in the region ranged from approximately 12 to 1320 individuals. The most active site during those 12 days was Bradbury Mountain in Maine. Passage rates at nearby sites were 8.4 raptors per observer hour at Bradbury Mountain in Maine. Barre Falls, Massacusetts had a seasonal passage rate of 6.1 raptors/observer hour and at Shatterack Mountain, Massachusetts there were 3.5 raptors/observation hour. The overall seasonal passage rate at Oakfield was 0.73 raptors per observation hour (Appendix C, Table 4). Hawkwatch sites that are located at prominent topographical points, such as Hawk Mountain, PA and Allegheny Front, are along popular migratory routes consisting of long ridgelines with generally north to south orientations, and, therefore, serve as leading lines for migrants. Organized hawk count locations typically target areas of known concentrated raptor migration activity. Therefore, publicly available results of past spring surveys done at other wind sites in the region are included (Appendix C, Table 5).

The Stetson Mountain seasonal passage rate was comparable to that at Oakfield. Both sites are topographically similar with numerous Laurentian hills, wetlands and drainages across the landscape. Mars Hill topography is somewhat similar in that both share linear ridgelines but the landscape surrounding Mars Hill show elevation changes to be more gradual than at Sam Drew Mountain. Other publicly available data from wind sites in New England are Deerfield, VT and Lempster, NH and show higher seasonal passage rates than Oakfield.

There are several reasons for the variations in raptors observed among hawk watch sites in spring, including survey effort, geographical location, and visibility. Geographical location can affect the magnitude of raptor migration at a particular site. Survey efforts vary from site to site. Organized hawk watch locations are usually surveyed when the weather is optimal for raptor migration and typically during the peak of the migration season. There are, of course, various peak migration periods for different species, as well variations among juvenile and adult birds of the same species.

The flight heights of raptors observed in the Project area indicate that migrating raptors occur in the zone of the blade-swept area of the proposed turbines. Of the total number of individual raptors observed, 76 percent were observed below 120 m (394') for at least a portion of their flight through the Project area; however, only 32 percent were observed directly over Sam Drew Mountain.

Flight height of raptors varied by survey day, individual raptor, and species. Variations in the flight heights of raptors are due to the particular flight behaviors of raptor species, as well as daily weather conditions. Typically, accipiters and falcons use up-drafts from side slopes to gain lift and, therefore, fly low over ridgelines. Buteos tend to use lift from thermals that develop over side slopes and valleys and tend to fly high during hours of peak thermal development. Raptors typically fly lower than usual during windy or inclement conditions. Typically, accipiters and falcons use up-drafts from side slopes to gain lift and, therefore, fly low over ridgelines.

Flight patterns showed that Sam Drew Mountain serves as a leading line as a majority of raptors (80 percent) utilized updrafts and thermals above the ridgeline and upper slopes or crest of the ridgeline. Flight patterns revealed no preference between flying parallel or perpendicular to the ridgeline. No observations were made of raptors flying over the saddle between Sam Drew Mountain and Oakfield Hills.

Migration of raptors is a dynamic process due to various behavioral and environmental factors. As a result, flight pathways and movements along ridges, side slopes, and across valleys may vary seasonally, daily, or hourly. Raptors may shift and use different ridge lines and cross different valleys from year to year or season to season. Weather and wind are major factors that influence migration pathways. The flight paths of raptors observed in the Project area varied between survey dates and were influenced by varying wind direction and weather. Wind strongly affects the propensity of raptors to concentrate along linear features (such as rivers and ridges). The precise location of the migrants relative to a linear feature is what directs concentrations of migrating birds along linear features and can be related to lateral drift caused by crosswinds (Richardson 1998).

Peer reviewed research and first hand observations that detail flight behavior of raptors through wind sites show that raptors use the updrafts and thermals created along leading lines during migration and foraging (Barrios & Rodriguez, 2004; Hoover & Morrison, 2005). Both behaviors are known to increase collision risk. However, peer reviewed studies have also documented high raptor collision avoidance behaviors at modern wind facilities (Whitfield and Madders 2006, Chamberlain *et al.* 2006). The mechanism of raptor turbine avoidance is unknown; however, as most raptors are diurnal, raptors may be able to visually, as well as acoustically detect turbines. Unpublished observations of hawk migration activity at an existing wind facility in New England indicate raptors have been observed rising above operating turbines and then decreasing altitude between turbines. It is unclear if this type of presumed avoidance behavior would be characteristic of raptors in general, and could therefore be expected at other wind turbine facilities in the East. It is also common for mortality studies to incorporate correctional factors, such as searcher efficiency and scavenging rates, to adjust previous fatality numbers into mortality estimates (Smallwood and Thelander 2008).

Although the greater occurrence of migrants at low altitudes increases the potential for migrating raptors to come into the vicinity of the proposed wind turbines, raptor mortality in the United States, outside of California, has been documented to be very low. For example, mortality rates found at onshore wind developments, outside of Altamont Pass in California, have documented 0 to 0.07 fatalities/turbine/year from 2000-2004 (GAO 2005). A more recent study at the Maple Ridge Wind Power facility in New York also documented very low raptor mortality. Only a single American kestrel was found, in a one year study covering 50 of 120 operational turbine sites (Jain *et al* 2007). Additionally, several other studies conducted recently in the U.S have documented few raptor fatalities and scarcely more than 15 fatalities have been reported at more than a dozen sites surveyed. During on-going, year-long, post-construction surveys at the Mars Hill Wind farm, Stantec has to-date not encountered any hawk or eagle carcasses, despite relatively similar habitat use and pre-construction data documenting the presence of eagles (Stantec unpublished data).

4.5 CONCLUSIONS

Raptor passage rates observed at different sites in the region vary due to topography, location, season, weather, and visibility. The spring 2008 passage rate at Oakfield is low in comparison to other HMANA sites in the region during the same timeframe, and is similar to passage rates observed at other proposed wind farms in the region where visibility and topography are generally comparable.

Although 76 percent of observed flights in the Project area occurred below the maximum rotor-zone of the proposed turbines, only 32 percent were observed flying directly over Sam Drew Mountain. Despite the generally low observed flight heights of raptors (generally 9 to 89 percent of migrants occur below the rotor-zone at proposed wind farms in the region), raptors have demonstrated high turbine collision avoidance behaviors as well as relatively low collision mortality at existing wind farms.

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Appendix A

Radar Survey Results

Appendix A Table 1. Survey dates, results, level of effort, and weather - Spring 2008

Date	Passage rate	Flight Direction	Flight Height (m)	% below 120 m	Hours of Survey	Temperature (c)	Wind Speed (m/s)	Wind Direction (from)
5/1/08	132	142.765°	143	62%	9	-1.3	8.5	328.1
5/2/08	399	346.751°	519	12%	9	2.4	6.2	104.4
5/3/08	775	38.63°	265	20%	9	4.6	7.3	182.0
5/7/08	610	58.313°	441	13%	8	9.1	6.0	205.2
5/9/08	660	279.652°	231	37%	9	5.3	8.4	66.8
5/11/08	393	311.514°	169	36%	9	4.2	8.0	72.5
5/12/08	606	326.716°	180	34%	9	6.8	6.9	52.7
5/13/08	455	12.949°	263	32%	9	8.6	5.7	77.0
5/14/08	789	358.851°	421	20%	9	9.4	7.5	127.0
5/19/08	341	74.894°	111	61%	6	4.7	9.1	268.7
5/20/08	607	43.495°	294	22%	9	8.4	2.4	131.3
5/21/08	682	39.033°	401	13%	9	7.3	3.9	194.9
5/26/08	899	32.079°	350	9%	8	10.5	8.8	197.6
5/27/08	261	101.068°	169	45%	8	3.7	10.5	312.2
5/28/08	654	53.188°	141	57%	9	8.1	9.9	255.5
5/29/08	189	133.151°	189	52%	9	5.5	8.8	322.6
5/30/08	573	45.868°	303	24%	9	10.0	7.6	223.8
6/1/08	273	178.876°	390	17%	9	8.0	7.9	342.6
6/2/08	409	57.311°	350	16%	9	11.1	6.9	268.8
6/3/08	254	80.569°	187	36%	9	11.1	4.1	307.8

Appendix A Table 2. Summary of passage rates by hour, night, and for entire season.

Night of	Passage Rate (targets/km/hr) by hour after sunset									Entire Night		
	1	2	3	4	5	6	7	8	9	Mean	Stdev	SE
5/1/08	330	336	96	121	93	38	43	57	75	132	117	39
5/2/08	311	425	229	340	369	474	584	463	393	399	104	35
5/3/08	1213	1406	1221	1196	825	497	367	204	43	775	509	170
5/7/08	307	518	498	511	732	766	830	718	--	610	178	63
5/9/08	193	1046	1050	1110	1101	721	407	182	129	660	432	144
5/11/08	386	806	995	807	296	96	99	27	21	393	381	127
5/12/08	686	1200	861	664	557	543	346	429	164	606	302	101
5/13/08	150	450	407	454	536	718	536	471	377	455	152	51
5/14/08	450	817	836	846	711	754	879	1496	307	789	330	110
5/19/08	688	514	336	371	120	14	--	--	--	341	248	101
5/20/08	369	845	627	809	964	825	625	364	39	607	298	99
5/21/08	424	846	943	392	484	539	932	1414	161	682	383	128
5/26/08	--	861	677	846	1452	939	991	797	630	899	254	90
5/27/08	161	805	326	248	236	178	46	86	--	261	238	84
5/28/08	357	1024	914	932	857	632	543	446	179	654	294	98
5/29/08	152	298	240	279	193	225	182	133	0	189	89	30
5/30/08	129	1029	1075	621	734	677	407	419	64	573	355	118
6/1/08	439	763	437	250	193	136	159	75	7	273	235	78
6/2/08	143	636	514	450	443	536	551	391	21	409	201	67
6/3/08	204	632	434	199	114	150	220	182	150	254	169	56
Entire Season	373	763	636	572	551	473	460	440	162	**498**	**218**	**49**

Appendix A Table 3. Mean Nightly Flight Direction		
Night of	**Mean Flight Direction**	***Circular Stdev***
5/1/08	142.765°	46.778°
5/2/08	346.751°	60.811°
5/3/08	38.63°	30.834°
5/7/08	58.313°	62.383°
5/9/08	279.652°	50.008°
5/11/08	311.514°	39.223°
5/12/08	326.716°	77.334°
5/13/08	12.949°	60.501°
5/14/08	358.851°	35.479°
5/19/08	74.894°	33.386°
5/20/08	43.495°	46.247°
5/21/08	39.033°	41.729°
5/26/08	32.079°	30.111°
5/27/08	101.068°	45.292°
5/28/08	53.188°	24.314°
5/29/08	133.151°	68.729°
5/30/08	45.868°	22.742°
6/1/08	178.876°	61.131°
6/2/08	57.311°	28.265°
6/3/08	80.569°	67.999°
Entire Season	33.478°	65.445°

Appendix A Table 4. Summary of mean flight heights by hour, night, and for entire season.

Night of	Mean Flight Height (m) by hour after sunset										Entire Night			% of targets below 120 meters
	1	2	3	4	5	6	7	8	9	10	Mean	STDV	SE	
5/1/08	--	--	117	257	265	154	25	27	153	--	143	97	37	62%
5/2/08	249	645	660	597	582	615	493	494	340	--	519	142	47	12%
5/3/08	203	289	256	325	325	276	175	273	--	--	265	53	19	20%
5/7/08	197	362	594	574	485	--	479	397	--	--	441	137	52	13%
5/9/08	124	181	262	255	253	282	281	266	295	107	231	68	22	37%
5/11/08	176	250	238	262	267	106	128	59	--	38	169	90	30	36%
5/12/08	177	253	173	154	184	159	199	203	119	--	180	37	12	34%
5/13/08	181	349	440	360	397	160	205	173	105	--	263	123	41	32%
5/14/08	196	458	502	483	476	460	382	294	541	--	421	111	37	20%
5/19/08	142	--	129	126	85	73	--	--	--	--	111	30	13	61%
5/20/08	222	283	329	244	257	284	411	361	258	--	294	61	20	22%
5/21/08	279	371	307	424	456	498	542	402	335	--	401	88	29	13%
5/26/08	--	419	346	320	425	426	316	272	272	--	350	66	23	9%
5/27/08	363	213	184	167	144	125	238	85	5.2	--	169	101	34	45%
5/28/08	140	174	134	163	140	127	111	131	150	--	141	19	6	57%
5/29/08	121	209	104	83	146	84	80	157	716	--	189	202	67	52%
5/30/08	242	318	240	224	239	350	297	355	460	--	303	77	26	24%
6/1/08	182	367	395	329	302	422	356	766	--	--	390	168	60	17%
6/2/08	283	410	406	417	366	327	354	290	295	--	350	54	18	16%
6/3/08	165	261	241	161	146	172	172	130	237	--	187	47	16	36%
Entire Season	202	323	303	294	297	268	276	270	285	73	**276**	**117**	**26**	**21%**

-- indicates no data for that hour

Appendix A Table 5. Bird and bat targets observed during radar and ceilometer surveys.

Night of	Radar Results				Ceilometer Results	
	Possible Bird Targets	Possible Bat Targets	Likely Insects	# of Obs Periods	Birds	Bats
5/1/08	100%	0%	0%			
5/2/08	100%	0%	0%			
5/3/08	100%	0%	0%			
5/7/08	100%	0%	0%			
5/9/08	100%	0%	0%			
5/11/08	100%	0%	0%			
5/12/08	98%	2%	0%			
5/13/08	100%	0%	0%			
5/14/08	100%	0%	0%			
5/19/08	100%	0%	0%	5	0	1
5/20/08	100%	0%	0%	5	3	1
5/21/08	100%	0%	0%	6	3	1
5/26/08	100%	0%	0%	4	0	6
5/27/08	100%	0%	0%	4	1	1
5/28/08	100%	0%	0%	5	1	2
5/29/08	100%	0%	0%	5	1	8
5/30/08	100%	0%	0%	5	5	8
6/1/08	100%	0%	0%	5	5	8
6/2/08	100%	0%	0%	5	4	16
6/3/08	100%	0%	0%	5	16	14
Total	**100%**	**0%**	**0%**	**54**	**39**	**66**

Appendix A Table 6. Summary of available spring avian radar survey results.

Project Site	No. of Survey Nights	No. of Survey Hours	Landscape	Average Passage Rate (t/km/hr)	Range in Nightly Passage Rates	Average Flight Direction	Average Flight Height (m)	(Turbine Ht) % Targets Below Turbine Height	Citation
Spring 2003									
Westfield Chautauqua Cty, NY	30	150	Great Lakes Shore	395	15-1702	29	528	(125 m) 4%	Cooper *et al.* 2004
Spring 2005									
Churubusco, Clinton Cty, NY	39	310	Great Lakes plain/ADK foothills	254	3-728	40	422	(120 m) 11%	Woodlot 2005a
Ellenberg, Clinton Cty, NY	n/a	n/a	Great Lakes plain/ADK foothills	110	n/a	30	338	(n/a) 20%	Mabee *et al.* 2006a
Dairy Hills, Clinton Cty, NY	n/a	n/a	Great Lakes shore	117	n/a	14	397	(n/a) 15%	ED&R 2006b
Clayton, Jefferson Cty, NY	36	303	Agricultural plateau	450	71-1769	30	443	(150 m) 14%	Woodlot 2005b
High Sheldon, Wyoming Cty, NY	38	272	Agricultural plateau	112	6-558	25	418	(120 m) 6%	Woodlot 2006a
Prattsburgh, Steuben Cty, NY	20	183	Agricultural plateau	277	70-621	22	370	(125 m) 16%	Woodlot 2005c
Prattsburgh, Steuben Cty, NY	30	270	Agricultural plateau	170	3-844	18	319	(125 m) 18%	Mabee *et al.* 2005a
Cohocton, Steuben Cty, NY	3	29	Agricultural plateau	371	133-773	28	609	(125 m) 12%	ED&R 2006a
Munnsville, Madison Cty, NY	41	388	Agricultural plateau	160	6-1065	31	291	(118 m) 25%	Woodlot 2005d
Fairfield, Herkimer Cty, NY	40	369	Agricultural plateau	509	80-1175	44	419	(125 m) 20%	Woodlot 2005e
Jordanville, Herkimer Cty, NY	40	364	Agricultural plateau	409	26-1410	40	371	(125 m) 21%	Woodlot 2005f
Sheffield, Caledonia Cty, VT	20	179	Forested ridge	208	11-439	40	522	(125 m) 6%	Woodlot 2006b
Deerfield, Bennington Cty, VT	20	183	Forested ridge	404	74-973	69	523	(125 m) 4%	Woodlot 2005g
Franklin, Pendleton Cty, WV	23	204	Forested ridge	457	34-240	53	492	(125 m) 11%	Woodlot 2005h
Spring 2006									
Chateaugay, Franklin Cty, NY	35	300	Agricultural plateau	360	54-892	48	409	(120 m) 18%	Woodlot 2006c
Wethersfield, Wyoming Cty, NY	44	n/a	Agricultural plateau	324	41-907	12	355	(125 m) 19%	Mabee et al. 2006b
Centerville, Allegany Cty, NY	42	n/a	Agricultural plateau	290	25-1140	22	351	(125 m) 16%	Mabee et al. 2006b
Howard, Steuben Cty, NY	42	440	Agricultural plateau	440	35-2270	27	426	(125 m) 13%	Woodlot 2006d
Deerfield, Bennington Cty, VT	26	236	Forested ridge	263	5-934	58	435	(100 m) 11%	Woodlot 2006e
Kibby, Franklin Cty, ME (Mtn)	6	33	Forested ridge	456	88-1500	67	368	(120 m) 14%	Woodlot 2006f
Kibby, Franklin Cty, ME (Range 1)	10	80	Forested ridge	197	6-471	50	412	(120 m) 22%	Woodlot 2006f
Kibby, Franklin Cty, ME (Range 2)	7	57	Forested ridge	512	18-757	86	378	(120 m) 25%	Woodlot 2006f
Kibby, Franklin Cty, ME (Valley)	2	14	Forested valley	443	45-1242	61	334	(120 m) n/a	Woodlot 2006f
Mars Hill, Aroostook Cty, ME	15	85	Forested ridge	338	76-674	58	384	(120 m) 14%	Woodlot 2006g
Spring 2007									
Stetson, Washington Cty, ME	21	138	Forested ridge	147	3 – 434	55	210	(120 m) 22%	Stantec 2007a
Lempster, Sullivan Cty, NH	30	277	Forested ridge	542	49-1094	49	358	(125 m) 18%	Woodlot 2007c
Coos Cty, NH	30	212	Forested ridge	342	2 - 870	76	332	(125 m) 14%	Stantec Consulting 2007a
Spring 2008									
Rollins, Penobscot Cty, ME	20	189	Forested ridge	247	40 - 766	75	316	(120 m) 13%	Stantec 2008a

Appendix B

Bat Survey Results

Appendix B Table 1. Summary of acoustic bat data and weather during each survey night at the Radar Met High detector – Spring 2008

		BBSHHB				RBEP			MYSP	UNKN							
Night of	Operated Okay?	big brown bat	hoary bat	silver-haired bat	silver-haired/big brown	eastern pipistrelle	eastern red bat	pipistrelle/red bat	MYSP	high-frequency	low-frequency	unknown	Total	Wind Speed (m/s)	Wind Direction (degrees)	Relative Humidity (%)	Temperature (celsius)
4/25/08	Yes												0	6.5	84.6	69.5	2.3
4/26/08	Yes												0	7.7	112.0	70.2	2.7
4/27/08	Yes												0	4.8	168.3	68.3	3.8
4/28/08	Yes												0	11.3	145.4	71.4	5.0
4/29/08	Yes												0	11.0	159.0	64.9	2.5
4/30/08	Yes												0	8.2	324.0	62.8	-2.3
5/1/08	Yes												0	8.5	328.1	55.1	-1.3
5/2/08	Yes												0	6.2	104.4	66.0	2.4
5/3/08	Yes												0	7.3	182.0	58.6	4.6
5/4/08	Yes												0	4.9	212.2	80.1	2.8
5/5/08	Yes												0	2.6	306.9	73.9	9.1
5/6/08	Yes												0	5.6	292.4	50.3	11.4
5/7/08	Yes												0	6.0	205.2	42.5	9.1
5/8/08	Yes											2	2	11.0	308.1	87.3	5.0
5/9/08	Yes												0	8.4	66.8	75.8	5.3
5/10/08	Yes												0	9.1	26.8	85.6	2.7
5/11/08	Yes												0	8.0	72.5	74.1	4.2
5/12/08	Yes												0	6.9	52.7	60.9	6.8
5/13/08	Yes												0	5.7	77.0	56.5	8.6
5/14/08	Yes												0	7.5	127.0	50.7	9.4
5/15/08	Yes												0	9.5	319.6	77.5	9.6
5/16/08	Yes											1	1	7.2	48.1	53.8	10.2
5/17/08	Yes												0	7.9	236.7	77.8	8.3
5/18/08	Yes												0	7.1	178.4	66.0	9.8
5/19/08	Yes												0	9.1	268.7	95.8	4.7
5/20/08	Yes												0	2.4	131.3	72.2	8.4
5/21/08	Yes												0	3.9	194.9	95.5	7.3
5/22/08	Yes												0	8.5	329.1	96.0	6.2
5/23/08	Yes												0	8.0	332.7	85.8	4.5
5/24/08	Yes												0	8.1	333.9	58.2	8.4
5/25/08	Yes												0	9.5	247.8	49.3	12.8
5/26/08	Yes												0	8.8	197.6	91.8	10.5
5/27/08	Yes												0	10.5	312.2	70.3	3.7
5/28/08	Yes												0	9.9	255.5	54.8	8.1
5/29/08	Yes												0	8.8	322.8	55.7	5.5
5/30/08	Yes												0	7.6	223.8	59.5	10.0
5/31/08	Yes												0	6.6	213.3	98.3	9.6
By Species		0	0	0	0	0	0	0	0	0	0	3	3				
By Guild		0				0			0	3							
		BBSHHB				RBEP			MYSP	UNKN			Total				

Appendix B Table 2. Summary of acoustic bat data and weather during each survey night at the Radar Met Low detector – Spring 2008

		BBSHHB				RBEP			MYSP	UNKN							
Night of	Operated Okay?	big brown bat	hoary bat	silver-haired bat	silver-haired/big brown	eastern pipistrelle	eastern red bat	pipistrelle/red bat	MYSP	high-frequency	low-frequency	unknown	Total	Wind Speed (m/s)	Wind Direction (degrees)	Relative Humidity (%)	Temperature (celsius)
4/25/08	Yes												0	6.5	84.6	69.6	2.3
4/26/08	Yes												0	7.7	112.0	70.2	2.7
4/27/08	Yes												0	4.8	168.3	68.3	3.8
4/28/08	Yes											1	1	11.3	145.4	71.4	5.0
4/29/08	Yes												0	11.0	159.0	64.9	2.5
4/30/08	Yes												0	8.2	324.0	82.8	-2.3
5/1/08	Yes												0	8.5	328.1	55.1	-1.3
5/2/08	Yes												0	6.2	104.4	66.0	2.4
5/3/08	Yes											1	1	7.3	182.0	58.6	4.6
5/4/08	Yes												0	4.8	212.2	60.1	2.8
5/5/08	Yes								1			1	2	2.6	306.9	73.9	9.1
5/6/08	Yes								2				2	6.6	292.4	50.3	11.4
5/7/08	Yes								1				1	6.0	205.2	42.5	9.1
5/8/08	Yes												0	11.0	306.1	87.3	5.0
5/9/08	Yes												0	8.4	66.8	75.8	5.3
5/10/08	Yes												0	9.1	26.8	85.6	2.7
5/11/08	Yes												0	8.0	72.5	74.1	4.2
5/12/08	Yes												0	6.9	52.7	60.9	6.8
5/13/08	Yes											1	1	5.7	77.0	56.5	8.6
5/14/08	Yes								1				1	7.5	127.0	50.7	9.4
5/15/08	Yes												0	9.5	319.6	77.5	9.6
5/16/08	Yes								1				1	7.2	48.1	63.8	10.2
5/17/08	Yes											1	1	7.9	236.7	77.8	6.3
5/18/08	Yes								1				1	7.1	178.4	68.0	9.8
5/19/08	Yes												0	9.1	268.7	95.8	4.7
5/20/08	Yes												0	2.4	131.3	72.2	8.4
5/21/08	Yes												0	3.9	194.9	95.5	7.3
5/22/08	Yes												0	8.5	329.1	96.0	6.2
5/23/08	Yes												0	8.0	332.7	85.8	4.5
5/24/08	Yes												0	8.1	333.9	58.2	8.4
5/25/08	Yes												0	9.5	247.8	49.3	12.6
5/26/08	Yes												0	8.8	197.6	91.8	10.5
5/27/08	Yes												0	10.5	312.2	70.3	3.7
5/28/08	Yes												0	9.9	255.5	54.8	8.1
5/29/08	Yes												0	8.8	322.6	65.7	5.6
5/30/08	Yes								1				1	7.6	223.8	59.5	10.0
5/31/08	Yes												0	6.6	213.3	98.3	9.8
By Species		0	0	0	0	0	0	0	8	0	0	5	13				
By Guild		0				0			8	5							
		BBSHHB				RBEP			MYSP	UNKN			Total				

Appendix B Table 3. Summary of acoustic bat data and weather during each survey night at the Radar Tree detector – Spring 2008

		BBSHHB				RBEP			MYSP	UNKN							
Night of	Operated Okay?	big brown bat	hoary bat	silver-haired bat	silver-haired/big brown	eastern pipistrelle	eastern red bat	pipistrelle/red bat	MYSP	high-frequency	low-frequency	unknown	Total	Wind Speed (m/s)	Wind Direction (degrees)	Relative Humidity (%)	Temperature (celsius)
4/25/08	No												0	8.6	84.8	69.5	2.3
4/26/08	No												0	7.7	112.0	70.2	2.7
4/27/08	No												0	4.8	168.3	68.3	3.6
4/28/08	No												0	11.3	145.4	71.4	5.0
4/29/08	No												0	11.0	159.0	64.9	2.5
4/30/08	No												0	8.2	324.0	62.8	-2.3
5/1/08	No												0	8.5	328.1	55.1	-1.3
5/2/08	No												0	6.2	104.4	66.0	2.4
5/3/08	No												0	7.3	182.0	58.6	4.6
5/4/08	No												0	4.9	212.2	80.1	2.8
5/5/08	No												0	2.6	306.9	73.9	9.1
5/6/08	No												0	6.6	292.4	50.3	11.4
5/7/08	No												0	6.0	205.2	42.5	9.1
5/8/08	Yes												0	11.0	306.1	87.3	5.0
5/9/08	Yes												0	8.4	66.6	75.8	5.3
5/10/08	Yes												0	9.1	26.8	85.6	2.7
5/11/08	Yes												0	6.0	72.5	74.1	4.2
5/12/08	Yes												0	6.9	52.7	60.9	6.8
5/13/08	Yes								1			3	4	5.7	77.0	56.5	8.6
5/14/08	Yes								41			11	52	7.5	127.0	50.7	9.4
5/15/08	Yes								2				2	9.5	319.6	77.5	9.6
5/16/08	Yes								41			2	43	7.2	48.1	53.8	10.2
5/17/08	Yes												0	7.8	236.7	77.8	8.3
5/18/08	Yes												0	7.1	178.4	66.0	9.8
5/19/08	Yes												0	9.1	268.7	95.8	4.7
5/20/08	Yes												0	2.4	131.3	72.2	8.4
5/21/08	Yes												0	3.9	194.9	95.5	7.3
5/22/08	Yes												0	8.5	329.1	96.0	6.2
5/23/08	Yes												0	8.0	332.7	85.8	4.5
5/24/08	Yes								26			10	36	8.1	333.9	58.2	8.4
5/25/08	Yes								43			17	60	9.5	247.8	49.3	12.8
5/26/08	Yes												0	8.8	197.6	91.8	10.5
5/27/08	Yes												0	10.5	312.2	70.3	3.7
5/28/08	Yes												0	9.9	255.5	54.8	8.1
5/29/08	Yes								11			6	17	8.8	322.6	55.7	5.5
5/30/08	Yes								1			3	4	7.6	223.8	59.5	10.0
5/31/08	Yes												0	6.6	213.3	98.3	9.6
By Species		0	0	0	0	0	0	0	166	0	0	52	218				
By Guild		0				0			166	52							
		BBSHHB				RBEP			MYSP	UNKN			Total				

Appendix B Table 4. Summary of acoustic bat data and weather during each survey night at the South Tree detector – Spring 2008

		BBSHHB				RBEP			MYSP	UNKN							
Night of	Operated Okay?	big brown bat	hoary bat	silver-haired bat	silver-haired/big brown	eastern pipistrelle	eastern red bat	pipistrelle/red bat	MYSP	high-frequency	low-frequency	unknown	Total	Wind Speed (m/s)	Wind Direction (degrees)	Relative Humidity (%)	Temperature (celsius)
5/1/08	Yes												0	8.5	328.1	69.5	-1.3
5/2/08	Yes								11			7	18	6.2	104.4	70.2	2.4
5/3/08	Yes								8			18	26	7.3	182.0	68.3	4.6
5/4/08	Yes												0	4.9	212.2	71.4	2.8
5/5/08	Yes								5			5	10	2.6	308.9	64.9	9.1
5/6/08	Yes								44			14	58	5.6	292.4	62.8	11.4
5/7/08	Yes								13			1	14	6.0	205.2	55.1	9.1
5/8/08	Yes											1	1	11.0	306.1	66.0	5.0
5/9/08	Yes												0	6.4	66.8	58.6	5.3
5/10/08	Yes												0	9.1	26.8	80.1	2.7
5/11/08	Yes								1			1	2	8.0	72.5	73.9	4.2
5/12/08	Yes								8			9	17	6.9	52.7	50.3	6.8
5/13/08	Yes								15			24	39	5.7	77.0	42.5	8.6
5/14/08	Yes						1		10			10	21	7.5	127.0	87.3	9.4
5/15/08	Yes								3			5	8	9.5	319.6	75.8	9.6
5/16/08	Yes						1		5			9	15	7.2	48.1	85.6	10.2
5/17/08	Yes											3	3	7.9	236.7	74.1	6.3
5/18/08	Yes												0	7.1	178.4	60.9	9.8
5/19/08	Yes												0	9.1	268.7	56.5	4.7
5/20/08	Yes								2				2	2.4	131.3	50.7	8.4
5/21/08	Yes								1				1	3.9	194.9	77.5	7.3
5/22/08	Yes								1				1	8.5	329.1	53.8	6.2
5/23/08	Yes								2				2	8.0	332.7	77.8	4.5
5/24/08	Yes								2				2	8.1	333.9	66.0	6.4
5/25/08	Yes								10			4	14	9.5	247.8	95.8	12.8
5/26/08	Yes												0	8.8	197.6	72.2	10.5
5/27/08	Yes												0	10.5	312.2	95.5	3.7
5/28/08	Yes								2				2	9.9	255.5	96.0	8.1
5/29/08	Yes								1			1	2	8.8	322.6	85.8	5.5
5/30/08	Yes								2			1	3	7.6	223.8	58.2	10.0
5/31/08	Yes												0	6.6	213.3	49.3	9.6
By Species		0	0	0	0	0	2	0	146	0	0	113	261				
By Guild		0				2			146	113							
		BBSHHB				RBEP			MYSP	UNKN			Total				

Appendix B Table 5. Summary of acoustic bat data and weather during each survey night at the Road Tree detector – Spring 2008

		BBSHHB				RBEP			MYSP	UNKN							
Night of	Operated Okay?	big brown bat	hoary bat	silver-haired bat	silver-haired/big brown	eastern pipistrelle	eastern red bat	pipistrelle/red bat	MYSP	high-frequency	low-frequency	unknown	Total	Wind Speed (m/s)	Wind Direction (degrees)	Relative Humidity (%)	Temperature (celsius)
5/1/08	Yes												0	6.5	326.1	55.1	-1.3
5/2/08	Yes											5	5	6.2	104.4	66.0	2.4
5/3/08	Yes											1	1	7.3	182.0	58.6	4.6
5/4/08	Yes												0	4.9	212.2	80.1	2.8
5/5/08	Yes												0	2.6	306.9	73.9	9.1
5/6/08	Yes												0	5.6	292.4	50.3	11.4
5/7/08	Yes											1	1	6.0	205.2	42.5	9.1
5/8/08	Yes											2	2	11.0	306.1	87.3	5.0
5/9/08	Yes								2			2	4	8.4	66.8	75.8	5.3
5/10/08	Yes												0	9.1	26.8	85.6	2.7
5/11/08	Yes								5			1	6	8.0	72.5	74.1	4.2
5/12/08	Yes								12			12	24	6.9	52.7	60.9	6.8
5/13/08	Yes								10			6	16	5.7	77.0	56.5	8.6
5/14/08	Yes								9			11	20	7.5	127.0	50.7	9.4
5/15/08	Yes												0	9.5	319.6	77.5	9.8
5/16/08	Yes								2			6	8	7.2	48.1	53.8	10.2
5/17/08	Yes				1								1	7.9	236.7	77.8	8.3
5/18/08	Yes								1				1	7.1	178.4	66.0	9.8
5/19/08	Yes												0	9.1	268.7	85.8	4.7
5/20/08	Yes								6				6	2.4	131.3	72.2	8.4
5/21/08	Yes								2			1	3	3.9	194.9	95.5	7.3
5/22/08	Yes												0	8.5	329.1	96.0	6.2
5/23/08	Yes												0	8.0	332.7	85.8	4.5
5/24/08	Yes											2	2	8.1	333.9	58.2	8.4
5/25/08	Yes												0	9.5	247.8	49.3	12.8
5/26/08	Yes												0	8.8	197.6	91.8	10.5
5/27/08	Yes												0	10.5	312.2	70.3	3.7
5/28/08	Yes								1			1	2	9.9	255.5	54.8	8.1
5/29/08	Yes								2				2	8.8	322.6	55.7	5.5
5/30/08	Yes											1	1	7.8	223.8	59.5	10.0
5/31/08	Yes												0	6.6	213.3	98.3	9.6
By Species		0	0	0	1	0	0	0	52	0	0	52	105				
By Guild		1				0			52	52							
		BBSHHB				RBEP			MYSP	UNKN			Total				

Appendix B Table 6. Summary of acoustic bat data and weather during each survey night at the Radar Met High detector – Summer 2008

		BBSHHB				RBEP			MYSP	UNKN						
Night of	Operated Okay?	big brown bat	hoary bat	silver-haired bat	silver-haired/big brown	eastern pipistrelle	eastern red bat	pipistrelle/red bat	MYSP	high-frequency	low-frequency	unknown	Total	Wind Speed (m/s)	Wind Direction (degrees)	Temperature (celsius)
6/1/08	yes												0	8.1	340.3	8.0
6/2/08	yes												0	7.1	268.6	11.2
6/3/08	yes												0	3.9	323.2	11.1
6/4/08	yes												0	5.5	74.4	8.0
6/5/08	yes												0	7.8	184.2	11.4
6/6/08	yes												0	5.5	216.2	8.3
6/7/08	yes										1		1	8.8	249.2	17.7
6/8/08	yes												0	8.3	316.1	17.8
6/9/08	yes									1			1	7.3	127.8	16.4
6/10/08	yes												0	7.4	188.5	15.1
6/11/08	yes												0	10.1	309.7	11.0
6/12/08	yes												0	11.2	327.8	11.3
6/13/08	yes				1				5	3	1		10	4.8	39.0	13.7
6/14/08	yes												0	6.4	105.5	12.0
6/15/08	yes												0	4.9	153.4	12.8
6/16/08	yes												0	8.0	156.4	11.9
6/17/08	yes												0	4.9	128.2	11.5
6/18/08	yes												0	5.2	162.0	10.3
6/19/08	yes									2			2	5.6	178.0	10.8
6/20/08	yes								1				1	5.3	219.6	12.1
6/21/08	yes												0	6.8	231.8	15.4
6/22/08	yes				1								1	7.3	196.7	15.1
6/23/08	yes												0	7.5	242.0	16.1
6/24/08	yes										3		3	9.5	315.0	12.9
6/25/08	yes												0	8.6	253.0	18.9
6/26/08	yes			3					3	3	1		10	2.5	121.0	15.1
6/27/08	yes								1				1	5.8	109.1	11.3
6/28/08	yes												0	10.0	118.2	11.7
6/29/08	yes												0	6.2	148.1	14.0
6/30/08	yes												0	6.6	255.6	17.7
7/1/08	yes									2			2	4.5	284.6	18.2
7/2/08	yes												0	7.7	204.0	17.4
7/3/08	yes												0	8.2	305.7	13.5
7/4/08	yes									1	1		2	7.0	278.7	15.7
7/5/08	yes												0	8.3	244.5	17.2
7/6/08	yes												0	8.4	240.3	18.4
7/7/08	yes												0	8.2	261.6	21.6
7/8/08	yes												0	7.3	218.2	21.3
7/9/08	yes												0	5.5	265.5	18.4
7/10/08	yes									1	1		2	9.9	291.0	13.8
7/11/08	n/o												0	6.2	322.2	14.3
7/12/08	n/o												0	9.2	191.2	15.8
7/13/08	n/o												0	11.9	164.2	16.6
7/14/08	n/o												0	6.7	261.6	17.5
7/15/08	n/o												0	6.7	296.9	18.9
7/16/08	n/o												0	5.8	237.4	18.7
7/17/08	n/o												0	4.8	26.1	17.8
7/18/08	n/o												0	2.4	179.6	15.3
7/19/08	n/o												0	3.3	248.6	15.9
7/20/08	n/o												0	4.2	130.9	16.9
7/21/08	n/o												0	5.8	81.2	16.4
7/22/08	n/o												0	6.5	87.6	14.5
7/23/08	n/o												0	8.7	119.0	18.5
7/24/08	n/o												0	11.1	182.1	19.1
7/25/08	n/o												0	6.0	235.7	17.3
7/26/08	n/o												0	8.5	168.7	16.5
7/27/08	n/o												0	5.3	183.6	17.2
7/28/08	n/o												0	5.9	230.5	16.7
7/29/08	n/o												0	8.4	305.8	14.8
7/30/08	n/o												0	4.4	271.1	17.9
7/31/08	n/o												0	6.7	136.4	15.8
8/1/08	n/o												0	6.3	152.0	17.1
8/2/08	n/o												0	6.8	138.2	16.9
8/3/08	n/o												0	4.8	94.9	15.5
8/4/08	n/o												0	8.2	18.2	12.2
8/5/08	yes												0	4.3	177.0	13.1
8/6/08	yes												0	2.6	160.3	12.4
8/7/08	yes												0	4.5	150.5	12.3
8/8/08	yes												0	2.9	14.2	13.0
8/9/08	yes												0	3.1	70.2	15.1
8/10/08	yes												0	4.0	130.9	15.4
8/11/08	yes								2	29	1		32	3.3	126.8	13.7
By Species		0	0	3	2	0	0	0	12	42	9	0	68			
By Guild		5				0			12	51			Total			
		BBSHHB				RBEP			MYSP	UNKN						

Appendix B Table 7. Summary of acoustic bat data and weather during each survey night at the Radar Met Low detector – Summer 2008

		BBSHHB				RBEP			MYSP	UNKN						
Night of	Operated Okay?	big brown bat	hoary bat	silver-haired bat	silver-haired/big brown	eastern pipistrelle	eastern red bat	pipistrelle/red bat	MYSP	high-frequency	low-frequency	unknown	Total	Wind Speed (m/s)	Wind Direction (degrees)	Temperature (celsius)
6/1/08	yes									1			1	8.1	340.3	8.0
6/2/08	yes												0	7.1	268.8	11.2
6/3/08	yes									2			2	3.9	323.2	11.1
6/4/08	yes												0	5.5	74.4	8.0
6/5/08	yes								1				1	7.8	184.2	11.4
6/6/08	yes												0	5.5	210.2	8.3
6/7/08	yes												0	8.8	249.2	17.7
6/8/08	yes												0	9.3	310.1	17.8
6/9/08	yes												0	7.3	127.8	16.4
6/10/08	yes												0	7.4	188.5	15.1
6/11/08	yes												0	10.1	309.7	11.0
6/12/08	yes												0	11.2	321.8	11.3
6/13/08	yes								1	11	1		13	4.8	39.0	13.7
6/14/08	yes								2	2			4	6.4	105.5	12.8
6/15/08	yes												0	4.9	153.4	12.8
6/16/08	yes												0	8.0	158.4	11.9
6/17/08	yes								1				1	4.9	128.2	11.5
6/18/08	yes												0	5.2	162.0	10.3
6/19/08	yes								2	2			4	5.6	178.0	10.8
6/20/08	yes									1			1	5.3	219.8	12.1
6/21/08	yes								1	1			2	8.8	231.8	15.4
6/22/08	yes												0	7.3	198.7	15.1
6/23/08	yes									1			1	7.5	242.0	16.1
6/24/08	yes				2								2	9.8	315.0	12.9
6/25/08	yes								2	2			4	8.6	253.9	16.9
6/26/08	yes												0	2.5	121.0	15.1
6/27/08	yes												0	5.8	109.1	11.3
6/28/08	yes												0	10.0	118.2	11.7
6/29/08	yes								1				1	6.2	148.1	14.0
6/30/08	yes									3			3	6.6	255.6	17.7
7/1/08	yes								1	11			12	4.5	254.8	18.2
7/2/08	yes								1				1	7.7	204.0	17.4
7/3/08	yes								2	4			6	8.2	305.7	13.5
7/4/08	yes								4	3			7	7.0	278.7	15.7
7/5/08	yes												0	8.3	244.5	17.2
7/6/08	yes									1			1	8.4	240.3	18.4
7/7/08	yes								2				2	8.2	261.8	21.6
7/8/08	yes												0	7.3	218.2	21.3
7/9/08	yes									3			3	5.5	265.5	18.4
7/10/08	yes							1		1			2	9.9	291.0	13.8
7/11/08	yes												0	6.2	322.2	14.3
7/12/08	yes								2				2	9.2	191.2	15.8
7/13/08	yes												0	11.0	184.2	15.6
7/14/08	yes												0	6.7	261.6	17.5
7/15/08	yes									2			2	6.7	298.9	16.9
7/16/08	yes								1	2			3	5.8	237.4	18.7
7/17/08	yes				1				1		2		4	4.8	26.1	17.8
7/18/08	yes								1				1	2.4	179.8	15.3
7/19/08	yes								4				4	3.3	248.6	15.9
7/20/08	yes				1					1			2	4.2	130.9	16.9
7/21/08	yes												0	5.8	81.2	16.4
7/22/08	yes												0	6.5	87.8	14.5
7/23/08	yes												0	8.7	119.0	16.5
7/24/08	yes								1				1	11.1	162.1	19.1
7/25/08	yes								1	1			2	6.0	235.7	17.3
7/26/08	yes								1	2			3	8.5	180.7	16.5
7/27/08	yes								1	1			2	5.3	183.8	17.2
7/28/08	yes												0	5.9	230.5	10.7
7/29/08	yes												0	8.4	305.8	14.8
7/30/08	yes								1	2	1		4	4.4	271.1	17.9
7/31/08	yes								1	1			2	6.7	138.4	15.9
8/1/08	yes								1				1	6.3	152.0	17.1
8/2/08	yes												0	6.8	138.2	16.9
8/3/08	yes												0	4.8	84.9	15.5
8/4/08	yes												0	8.2	18.2	12.2
8/5/08	yes									1			1	4.3	177.0	13.1
8/6/08	yes												0	2.6	168.3	12.4
8/7/08	yes									1			1	4.5	150.5	12.3
8/8/08	yes												0	2.9	14.2	13.0
8/9/08	yes												0	3.1	70.2	15.1
8/10/08	yes									1			1	4.0	130.9	15.4
8/11/08	yes								1	18			19	3.3	126.6	13.7
By Species		0	0	0	4	0	0	1	38	82	4	0	129			
By Guild		4				1			38	86						
		BBSHHB				RBEP			MYSP	UNKN			Total			

Appendix B Table 6 Summary of acoustic bat data and weather during each survey night at the Radar Met Tree detector – Summer 2008

		BBSHHB				RBEP			MYSP	UNKN						
Night of	Operated Okay?	big brown bat	hoary bat	silver-haired bat	silver-haired/big brown	eastern pipistrelle	eastern red bat	pipistrelle/red bat	MYSP	high-frequency	low-frequency	unknown	Total	Wind Speed (m/s)	Wind Direction (degrees)	Temperature (celsius)
6/1/08	yes									14			14	6.1	340.3	8.0
6/2/08	yes								4	31			35	7.1	268.6	11.2
6/3/08	yes								22	13			35	3.9	323.2	11.1
6/4/08	yes									1			1	5.5	74.4	6.0
6/5/08	yes								2	2			4	7.8	184.2	11.4
6/6/08	yes												0	5.5	216.2	8.3
6/7/08	yes								1	2			3	8.8	249.2	17.7
6/8/08	yes								4	6			10	9.3	316.1	17.6
6/9/08	yes									3			3	7.3	127.8	16.4
6/10/08	yes												0	7.4	186.5	15.1
6/11/08	yes								25	12			37	10.1	309.7	11.0
6/12/08	yes								69	93			162	11.2	321.8	11.3
6/13/08	yes	1							151	98	1		251	4.8	39.0	13.7
6/14/08	yes								54	34			88	6.4	105.5	12.8
6/15/08	yes									2			2	4.9	153.4	12.8
6/16/08	yes												0	8.0	156.4	11.9
6/17/08	yes								7	4			11	4.9	128.2	11.5
6/18/08	yes									2			2	5.2	162.0	10.3
6/19/08	yes								13	11			24	5.6	178.0	10.8
6/20/08	yes								15	18			33	5.3	219.6	12.1
6/21/08	yes								15	11			26	6.8	231.8	15.4
6/22/08	yes									3			3	7.3	196.7	15.1
6/23/08	yes												0	7.5	242.0	16.1
6/24/08	yes								98	43	1		142	9.8	315.0	12.9
6/25/08	yes								34	20			54	8.6	253.9	16.9
6/26/08	yes								1	2			3	2.5	121.0	15.1
6/27/08	yes								1	2			3	5.8	109.1	11.3
6/28/08	yes												0	10.0	118.2	11.7
6/29/08	yes												0	6.2	148.1	14.0
6/30/08	yes								192	93			285	6.6	255.6	17.7
7/1/08	yes								221	108			329	4.5	284.6	16.2
7/2/08	yes								1	2			3	7.7	204.0	17.4
7/3/08	yes								278	135			413	6.2	305.7	13.5
7/4/08	yes								571	122			693	7.0	278.7	15.7
7/5/08	yes								24	5			29	8.3	244.5	17.2
7/6/08	yes								1	2			3	8.4	240.3	18.4
7/7/08	yes								24	25			49	8.2	261.6	21.6
7/8/08	yes												0	7.3	218.2	21.3
7/9/08	yes								61	36			97	5.5	265.5	18.4
7/10/08	yes								173	59	1		233	9.9	291.0	13.8
7/11/08	yes						1		217	104			322	6.2	322.2	14.3
7/12/08	yes								8	6			14	9.2	191.2	16.8
7/13/08	yes												0	11.9	184.2	16.6
7/14/08	yes								43	13			56	6.7	261.6	17.5
7/15/08	yes								372	103			475	6.7	296.9	16.9
7/16/08	yes								5	5			10	5.8	237.4	18.7
7/17/08	yes								31	9	1		41	4.8	25.1	17.8
7/18/08	yes								3	2			5	2.4	179.6	15.3
7/19/08	yes						1	1	113	15			130	3.3	248.6	15.9
7/20/08	yes								6	3			9	4.2	130.9	16.9
7/21/08	yes								1	1			2	5.8	61.2	16.4
7/22/08	yes								32	21	2		55	6.5	87.6	14.5
7/23/08	yes								4	7			11	8.7	119.0	16.5
7/24/08	yes									1			1	11.1	162.1	19.1
7/25/08	yes								1	1			2	6.0	235.7	17.3
7/26/08	yes									2			2	6.5	186.7	16.5
7/27/08	yes									2			2	5.3	183.6	17.2
7/28/08	yes								1	2			3	5.0	230.5	16.7
7/29/08	yes								7	12			19	8.4	305.8	14.8
7/30/08	yes								19	21			40	4.4	271.1	17.9
7/31/08	yes								7	5			12	6.7	138.4	15.9
8/1/08	yes												0	5.3	152.0	17.1
8/2/08	yes								2	2			4	6.8	138.2	16.9
8/3/08	yes								1	7			8	4.8	84.9	15.5
8/4/08	yes								3	2			5	6.2	16.2	12.2
8/5/08	yes								5	6			11	4.3	177.0	13.1
8/6/08	yes								7	6			13	2.6	166.3	12.4
8/7/08	yes								7	5			12	4.5	150.5	12.3
8/8/08	yes												0	2.9	44.2	13.0
8/9/08	yes								13	6			19	3.1	70.2	15.1
8/10/08	yes								3	4			7	4.0	130.9	15.4
8/11/08	yes								27	55			82	3.3	126.8	13.7
By Species		1	0	0	0	0	2	1	3000	1442	6	0	4452			
By Guild		1				3			3000	1448						
		BBSHHB				RBEP			MYSP	UNKN			Total			

Appendix B Table 9 Summary of acoustic bat data and weather during each survey night at the North Tree detector – Summer 2008

		BBSHHB				RBEP			MYSP	UNKN						
Night of	Operated Okay?	big brown bat	hoary bat	silver-haired bat	silver-haired/big brown	eastern pipistrelle	eastern red bat	pipistrelle/red bat	MYSP	high-frequency	low-frequency	unknown	Total	Wind Speed (m/s)	Wind Direction (degrees)	Temperature (celsius)
6/1/08	yes												0	8.1	340.3	6.0
6/2/08	yes												0	7.1	268.6	11.2
6/3/08	yes												0	3.6	323.2	11.1
6/4/08	yes								1				1	5.5	74.4	8.0
6/5/08	yes								1	1			2	7.8	164.2	11.4
6/6/08	yes												0	5.5	216.2	8.3
6/7/08	yes		1								1		2	8.8	249.2	17.7
6/8/08	yes								1	1			2	9.3	316.1	17.8
6/9/08	yes												0	7.3	127.8	16.4
6/10/08	yes												0	7.4	188.5	15.1
6/11/08	yes										1		1	10.1	309.7	11.0
6/12/08	yes								1				1	11.2	321.8	11.3
6/13/08	yes								1				1	4.8	39.0	13.7
6/14/08	yes										1		1	6.4	105.5	12.8
6/15/08	yes										1		1	4.9	153.4	12.8
6/16/08	yes										1		1	6.0	156.4	11.9
6/17/08	yes		1										1	4.9	128.2	11.5
6/18/08	yes												0	5.2	102.0	10.3
6/19/08	yes									1	2		3	5.6	178.0	10.8
6/20/08	yes										1		1	5.3	219.8	12.1
6/21/08	yes								1	1			2	6.8	231.8	15.4
6/22/08	yes												0	7.3	196.7	15.1
6/23/08	yes												0	7.5	242.0	16.1
6/24/08	yes				1				3	1			5	9.6	315.0	12.9
6/25/08	yes									1			1	8.6	253.9	16.9
6/26/08	yes								3	2			5	2.5	121.0	15.1
6/27/08	yes								1				1	5.8	109.1	11.3
6/28/08	yes												0	10.0	118.2	11.7
6/29/08	yes												0	6.2	148.1	14.0
6/30/08	yes								3	2			5	6.6	255.6	17.7
7/1/08	yes								6	4			10	4.5	284.6	18.2
7/2/08	yes									1	1		2	7.7	204.0	17.4
7/3/08	yes								3	2			5	8.2	305.7	13.5
7/4/08	yes								10	11			21	7.0	278.7	15.7
7/5/08	yes									1			1	9.3	244.5	17.2
7/6/08	yes												0	8.4	240.3	18.4
7/7/08	yes									2			2	8.2	201.6	21.8
7/8/08	yes												0	7.3	218.2	21.3
7/9/08	yes												0	5.5	265.5	16.4
7/10/08	yes								1				1	9.9	291.0	13.8
By Species		0	2	0	1	0	0	0	36	31	9	0	79			
By Guild		3				0			36	40						
		BBSHHB				RBEP			MYSP	UNKN			Total			

Appendix B Table 10. Summary of acoustic bat data and weather during each survey night at the South Tree detector – Summer 2008

		BBSHHB				RBEP			MYSP	UNKN						
Night of	Operated Okay?	big brown bat	hoary bat	silver-haired bat	silver-haired/big brown	eastern pipistrelle	eastern red bat	pipistrelle/red bat	MYSP	high-frequency	low-frequency	unknown	Total	Wind Speed (m/s)	Wind Direction (degrees)	Temperature (celsius)
6/1/08	yes								4	1			5	8.1	340.3	8.0
6/2/08	yes				1				7	2			10	7.1	268.6	11.2
6/3/08	yes									1			1	3.9	323.2	11.1
6/4/08	yes												0	5.5	74.4	8.0
6/5/08	yes								5		1		6	7.8	184.2	11.4
6/6/08	yes												0	5.5	216.2	8.3
6/7/08	yes								1				1	8.8	249.2	17.7
6/8/08	yes	1							5	3	2		11	9.3	316.1	17.8
6/9/08	yes								2	4			6	7.3	127.8	16.4
6/10/08	yes								1	1			2	7.4	188.5	15.1
6/11/08	yes								1	1	1		3	10.1	309.7	11.0
6/12/08	yes								5	4			9	11.2	321.8	11.3
6/13/08	yes								71	11	1		83	4.8	39.0	13.7
6/14/08	yes								18	5			23	6.4	105.5	12.8
6/15/08	yes								6				6	4.9	153.4	12.8
6/16/08	yes									2			2	8.0	156.4	11.9
6/17/08	yes								2	1			3	4.9	128.2	11.5
6/18/08	yes								2				2	5.2	162.0	10.3
6/19/08	yes								10	2			12	5.6	178.0	10.8
6/20/08	yes								15				15	5.3	219.6	12.1
6/21/08	yes								75	9			84	6.8	231.8	15.4
6/22/08	yes								10	2			12	7.3	196.7	15.1
6/23/08	yes								7		1		8	7.5	242.0	16.1
6/24/08	yes								36	8			44	9.8	315.0	12.9
6/25/08	yes								28	10			38	8.8	253.9	16.9
6/26/08	yes								1				1	2.5	121.0	15.1
6/27/08	yes								11	5			16	5.6	109.1	11.3
6/28/08	yes								1				1	10.0	118.2	11.7
6/29/08	yes								1		3		4	6.2	148.1	14.0
6/30/08	yes								21	5			26	6.6	255.6	17.7
7/1/08	yes								17	9			26	4.5	284.6	18.2
7/2/08	yes								17	1			18	7.7	204.0	17.4
7/3/08	yes								76	28			104	8.2	305.7	13.5
7/4/08	yes								248	29			277	7.0	278.7	15.7
7/5/08	yes								71	10			81	8.3	244.5	17.2
7/6/08	yes								16	6			22	8.4	240.3	18.4
7/7/08	yes								21	4			25	6.2	261.6	21.6
7/8/08	yes				1				3				4	7.3	218.2	21.3
7/9/08	yes								21	13			34	5.5	265.5	18.4
7/10/08	yes								126	13			139	9.9	291.0	13.8
By Species		1	0	0	2	0	0	0	962	190	9	0	1164			
By Guild		3				0			962	199						
		BBSHHB				RBEP			MYSP	UNKN			Total			

Appendix B Table 11. Summary of acoustic bat data and weather during each survey night at the Road Tree detector – Summer 2008

Night of	Operated Okay?	BBSHHB: big brown bat	BBSHHB: hoary bat	BBSHHB: silver-haired bat	BBSHHB: silver-haired/big brown	RBEP: eastern pipistrelle	RBEP: eastern red bat	RBEP: pipistrelle/red bat	MYSP: MYSP	UNKN: high-frequency	UNKN: low-frequency	UNKN: unknown	Total	Wind Speed (m/s)	Wind Direction (degrees)	Temperature (celsius)
6/1/08	yes								2	1			3	8.1	340.3	8.0
6/2/08	yes												0	7.1	268.6	11.2
6/3/08	yes								1	4			5	3.9	323.2	11.1
6/4/08	yes												0	5.5	74.4	8.0
6/5/08	yes									1			1	7.8	184.2	11.4
6/6/08	yes									1			1	5.5	216.2	8.3
6/7/08	yes				1				2		1		4	8.8	249.2	17.7
6/8/08	yes								1				1	8.3	310.1	17.8
6/9/08	yes								1	2			3	7.3	127.8	18.4
6/10/08	yes												0	7.4	188.5	15.1
6/11/08	yes								1				1	10.1	309.7	11.0
6/12/08	yes										1		1	11.2	321.8	11.3
6/13/08	yes								15	10			25	4.8	39.0	13.7
6/14/08	yes				1				4	4	1		10	6.4	105.5	12.8
6/15/08	yes								1	5	1		7	4.9	153.4	12.8
6/16/08	yes												0	8.0	156.4	11.9
6/17/08	yes												0	4.9	128.2	11.5
6/18/08	yes								2	1			3	5.2	162.0	10.3
6/19/08	yes									2			2	5.6	178.0	10.8
6/20/08	yes								1				1	5.3	219.6	12.1
6/21/08	yes								2	3			5	0.8	231.8	15.4
6/22/08	yes												0	7.3	196.7	15.1
6/23/08	yes												0	7.5	242.0	16.1
6/24/08	yes								1	1			2	9.8	315.0	12.9
6/25/08	yes								1	1	1		3	8.6	253.8	16.9
6/26/08	yes								3	1			4	2.5	121.0	15.1
6/27/08	yes								2	6			8	5.8	109.1	11.3
6/28/08	yes												0	10.0	118.2	11.7
6/29/08	yes								1	3			4	6.2	148.1	14.0
6/30/08	yes								5	1			6	6.6	255.6	17.7
7/1/08	yes								6	7			13	4.5	284.6	18.2
7/2/08	yes												0	7.7	204.0	17.4
7/3/08	yes								1	3			4	6.2	305.7	13.5
7/4/08	yes								8	11			19	7.0	278.7	15.7
7/5/08	yes								1	9			10	8.3	244.5	17.2
7/6/08	yes								1				1	8.4	240.3	18.4
7/7/08	yes								5	8			13	8.2	261.8	21.6
7/8/08	yes												0	7.3	218.2	21.3
7/9/08	yes								2	1			3	5.5	205.5	18.4
7/10/08	yes								1	2			3	9.9	291.0	13.8
By Species		0	0	0	2	0	0	0	71	88	5	0	166			
By Guild		2 (BBSHHB)				0 (RBEP)			71 (MYSP)	93 (UNKN)			Total			

Appendix B Table 12. Summary of acoustic bat data and weather during each survey night at the North Met High detector – Summer 2008

		BBSHHB				RBEP			MYSP	UNKN						
Night of	Operated Okay?	big brown bat	hoary bat	silver-haired bat	silver-haired/big brown	eastern pipistrelle	eastern red bat	pipistrelle/red bat	MYSP	high-frequency	low-frequency	unknown	Total	Wind Speed (m/s)	Wind Direction (degrees)	Temperature (celsius)
7/11/08	yes												0	6.2	322.2	14.3
7/12/08	yes												0	9.2	191.2	15.8
7/13/08	yes												0	11.9	184.2	16.6
7/14/08	yes												0	6.7	261.6	17.5
7/15/08	yes										1		1	6.7	206.9	16.9
7/16/08	yes												0	5.8	237.4	18.7
7/17/08	yes												0	4.8	28.1	17.8
7/18/08	yes												0	2.4	179.8	15.3
7/19/08	yes										1		1	3.3	248.6	15.9
7/20/08	yes												0	4.2	130.9	16.9
7/21/08	yes												0	5.8	81.2	16.4
7/22/08	yes												0	6.5	87.6	14.5
7/23/08	yes												0	8.7	119.0	16.5
7/24/08	yes												0	11.1	162.1	19.1
7/25/08	yes												0	6.0	235.7	17.3
7/26/08	yes												0	8.5	186.7	16.5
7/27/08	yes												0	5.3	183.6	17.2
7/28/08	yes												0	5.9	230.5	16.7
7/29/08	yes												0	8.4	305.8	14.8
7/30/08	yes												0	4.4	271.1	17.9
7/31/08	yes												0	6.7	136.4	15.9
8/1/08	yes												0	6.3	152.0	17.1
8/2/08	yes												0	6.8	138.2	16.9
8/3/08	yes												0	4.8	84.9	15.5
8/4/08	yes												0	8.2	16.2	12.2
8/5/08	yes												0	4.3	177.0	13.1
8/6/08	yes												0	2.6	168.3	12.4
8/7/08	yes												0	4.5	150.5	12.3
8/8/08	yes												0	2.9	14.2	13.0
8/9/08	yes										1		1	3.1	70.2	15.1
8/10/08	yes												0	4.0	130.9	15.4
8/11/08	yes												0	3.3	126.8	13.7
By Species		0	0	0	0	0	0	0	0	0	3	0	3			
By Guild		0				0			0	3						
		BBSHHB				RBEP			MYSP	UNKN			Total			

Appendix B Table 13. Summary of acoustic bat data and weather during each survey night at the North Met Low detector – Summer 2008

		BBSHHB				RBEP			MYSP	UNKN						
Night of	Operated Okay?	big brown bat	hoary bat	silver-haired bat	silver-haired/big brown	eastern pipistrelle	eastern red bat	pipistrelle/red bat	MYSP	high-frequency	low-frequency	unknown	Total	Wind Speed (m/s)	Wind Direction (degrees)	Temperature (celsius)
7/11/08	yes			1									1	6.2	322.2	14.3
7/12/08	yes												0	9.2	101.2	15.8
7/13/08	yes												0	11.9	184.2	16.6
7/14/08	yes												0	6.7	261.8	17.5
7/15/08	yes												0	6.7	296.9	16.9
7/16/08	yes												0	5.8	237.4	18.7
7/17/08	yes									1			1	4.8	26.1	17.8
7/18/08	yes												0	2.4	179.6	15.3
7/19/08	yes												0	3.3	248.6	15.9
7/20/08	yes												0	4.2	130.9	16.9
7/21/08	yes												0	5.8	81.2	16.4
7/22/08	yes												0	6.5	87.6	14.5
7/23/08	yes												0	8.7	119.0	16.5
7/24/08	yes												0	11.1	162.1	19.1
7/25/08	yes	1	1										2	6.0	235.7	17.3
7/26/08	yes									1			1	8.5	186.7	16.5
7/27/08	yes												0	5.3	183.6	17.2
7/28/08	yes												0	5.9	230.5	16.7
7/29/08	yes												0	8.4	305.8	14.8
7/30/08	yes									1			1	4.4	271.1	17.0
7/31/08	yes												0	6.7	136.4	15.9
8/1/08	yes												0	6.3	152.0	17.1
8/2/08	yes												0	6.8	138.2	16.9
8/3/08	yes												0	4.8	84.9	15.5
8/4/08	yes												0	8.2	18.2	12.2
8/5/08	yes												0	4.3	177.0	13.1
8/6/08	yes												0	2.6	166.3	12.4
8/7/08	yes												0	4.5	150.5	12.3
8/8/08	yes												0	2.9	14.2	13.0
8/9/08	yes								1				1	3.1	70.2	15.1
8/10/08	yes												0	4.0	130.9	15.4
8/11/08	yes						1			1			2	3.3	126.6	13.7
By Species		1	1	1	0	0	1	0	1	4	0	0	9			
By Guild		3				1			1	4						
		BBSHHB				RBEP			MYSP	UNKN			Total			

Appendix B Table 14. Summary of acoustic bat data and weather during each survey night at the South Met detector – Summer 2008

		BBSHHB				RBEP			MYSP	UNKN						
Night of	Operated Okay?	big brown bat	hoary bat	silver-haired bat	silver-haired/big brown	eastern pipistrelle	eastern red bat	pipistrelle/red bat	MYSP	high-frequency	low-frequency	unknown	Total	Wind Speed (m/s)	Wind Direction (degrees)	Temperature (celsius)
7/11/08	yes		1										1	6.2	322.2	14.3
7/12/08	yes									1			1	9 2	191.2	15.6
7/13/08	yes												0	11.9	184.2	16.6
7/14/08	yes							1					1	6 7	261 6	17.5
7/15/08	yes												0	6 7	296.9	15 9
7/16/08	yes												0	5.8	237.4	18 7
7/17/08	yes												0	4 8	26.1	17 8
7/18/08	yes		1										1	2 4	178.6	16 3
7/19/08	yes												0	3 3	248 6	15 9
7/20/08	yes								1				1	4.2	130.9	16.9
7/21/08	yes												0	5.8	81 2	16.4
7/22/08	yes									1			1	6.5	87.6	14.5
7/23/08	yes												0	8.7	119.0	16.5
7/24/08	yes												0	11.1	162.1	19.1
7/25/08	yes									1			1	6.0	235 7	17.3
7/26/08	yes												0	8.5	166.7	16.5
7/27/08	yes												0	5.3	183 6	17.2
7/28/08	yes										2		2	5.9	230 5	16.7
7/29/08	yes												0	8 4	305.8	14.8
7/30/08	yes												0	4 4	271.1	17.9
7/31/08	yes												0	6.7	136 4	15.9
8/1/08	yes												0	6.3	152.0	17.1
8/2/08	yes												0	6.8	138 2	18.9
8/3/08	yes									1			1	4 8	84 9	15.5
8/4/08	yes												0	8.2	16.2	12 2
8/5/08	yes										2		2	4.3	177.0	13.1
8/6/08	yes												0	2.6	166.3	12.4
8/7/08	yes	1											1	4.5	150.5	12 3
8/8/08	yes												0	2.9	14.2	13.0
8/9/08	yes		1										1	3.1	70 2	15.1
8/10/08	yes										1		1	4 0	130 9	15.4
8/11/08	yes								1	17			18	3 3	126.8	13 7
By Species		1	3	0	0	0	0	1	2	21	5	0	33			
By Guild		4				1			2	26						
		BBSHHB				RBEP			MYSP	UNKN			Total			

Appendix C Table 14. Summary of available spring bat detector surveys (results reported for individual detectors)

Year	Project	State	City	Habitat	Height (m)	Detector Nights	Start	End	Calls	Rate	Reference
Tree or low met detectors (under 15 m)											
2005	Deerfield	VT	Searsburg	forest edge	15	40	4/19	6/15	4	0.07	Woodlot 2005g
2005	Sheffield	VT	Sheffield	forest edge	10	4	5/12	5/29	0	0	Woodlot 2006h
2006	Howard	NY	Howard	field	8	35	4/15	6/3	29	0.8	Woodlot 2006d
2006	Lempster	NH	Lempster	forest edge	5	21	4/5	6/12	16	0.8	Woodlot 2007b
2006	Sheffield	VT	Sheffield	forest edge	8	38	4/24	6/13	840	22.1	Woodlot 2006b
2006	Sheffield	VT	Sheffield	forest edge	9	37	4/24	6/13	90	2.4	Woodlot 2006b
2006	*Sheffield*	*VT*	*Sheffield*	*forest edge*	*8*	*34*	*4/24*	*6/13*	*178*	*5.2*	*Woodlot 2006b*
2006	Deerfield	VT	Searsburg	forest edge	2	37	4/14	6/11	4	0.1	Woodlot 2006e
2008	Rollins	ME	Lincoln	forest edge	3	21	4/23	5/22	34	1.6	Stantec 2008a
2008	Rollins	ME	Lincoln	forest edge	3	29	4/23	5/22	16	0.6	Stantec 2008a
Met tower detectors											
2005	Clayton	NY	Clayton	forest edge	20	42	4/20	5/31	55	1.3	Woodlot 2005b
2005	Clayton	NY	Clayton	forest edge	15	36	4/20	5/31	12	0.3	Woodlot 2005b
2005	Cohocton	NY	Cohocton	field	30	29	5/2	5/30	21	0.7	Woodlot 2006i
2005	High Sheldon	NY	Sheldon	field	30	36	4/21	5/30	6	0.17	Woodlot 2006a
2005	Jordanville	NY	Jordanville	field	30	29	4/14	5/13	15	0.5	Woodlot 2005f
2005	Liberty Gap	WV	Harper	forest edge	30	21	4/17	6/7	2	0.1	Woodlot 2005h
2005	Liberty Gap	WV	Harper	forest edge	15	21	4/17	6/7	19	0.9	Woodlot 2005h
2005	Marble River	NY	Churubusco	field	30	46	4/14	5/30	12	0.3	Woodlot 2005a
2005	Prattsburgh	NY	Prattsburgh	field	30	17	4/15	5/10	8	0.5	Woodlot 2005c
2005	Prattsburgh	NY	Prattsburgh	field	15	20	4/11	5/30	8	0.4	Woodlot 2005c
2005	Sheffield	VT	Sheffield	forest edge	20	31	5/1	5/31	6	0.17	Woodlot 2006b
2005	*Stamford/Moresville*	NY	*Stamford*	*forest edge*	30	27	4/12	5/8	8	0.3	Woodlot 2007a
2005	West Hill/Munnsville	NY	Munnsville	field	30	22	5/10	5/31	6	0.3	Woodlot 2005d
2006	Chateaugay	NY	Chateaugay	field	40	54	4/16	6/8	117	2.2	Woodlot 2006c
2006	Chateaugay	NY	Chateaugay	field	20	54	4/16	6/8	103	1.9	Woodlot 2006c
2006	Brandon	NY	Brandon	field	15	38	4/7	6/4	848	22.3	Woodlot 2006c
2006	Brandon	NY	Brandon	field	30	36	4/7	6/4	114	3.2	Woodlot 2006c
2006	*Deerfield*	VT	Searsburg	forest edge	35	60	4/14	6/13	*4*	*0.1*	Woodlot 2006e
2006	Deerfield	VT	Searsburg	forest edge	15	47	4/14	5/31	0	0	Woodlot 2006e
2006	Deerfield	VT	Searsburg	forest edge	30	29	4/14	5/20	0	0	Woodlot 2006e
2006	Deerfield	VT	Searsburg	forest edge	15	21	4/14	5/16	7	0.3	Woodlot 2006e
2006	Howard	NY	Howard	field	50	36	4/15	6/4	5	0.1	Woodlot 2006d
2006	Howard	NY	Howard	field	20	45	4/15	6/7	16	0.4	Woodlot 2006d
2006	Kibby	ME	Eustis	forest edge	50	14	5/4	6/19	0	0	Woodlot 2006f
2006	Kibby	ME	Eustis	forest edge	50	24	5/4	6/19	0	0	Woodlot 2006f
2006	Kibby	ME	Eustis	forest edge	20	35	5/4	6/19	31	0.7	Woodlot 2006f
2006	Kibby	ME	Eustis	forest edge	50	35	5/4	6/19	0	0	Woodlot 2006f
2006	Lempster	NH	Lempster	forest edge	40	60	4/5	6/12	7	0.1	Woodlot 2007b
2006	Lempster	NH	Lempster	forest edge	20	50	4/5	6/12	3	0.1	Woodlot 2007b
2006	Sheffield	VT	Sheffield	forest edge	31	36	4/24	6/13	5	0.14	Woodlot 2006b
2007	Stetson	ME	Stetson	forest edge	30	47	4/24	6/18	52	1.1	Woodlot 2007a
2007	Stetson	ME	Stetson	forest edge	30	56	4/24	6/18	235	4.2	Woodlot 2007a
2007	Stetson	ME	Stetson	forest edge	30	56	4/24	6/18	36	0.6	Woodlot 2007a
2008	Rollins	ME	Lincoln	forest edge	40	52	4/23	6/13	29	0.6	Stantec 2008a
2008	*Rollins*	*ME*	*Lincoln*	*forest edge*	*20*	*23*	*4/23*	*6/13*	*40*	*1.7*	*Stantec 2008a*
2008	Rollins	ME	Lincoln	forest edge	40	23	5/22	6/14	3	0.1	Stantec 2008a
2008	Rollins	ME	Lincoln	forest edge	20	23	5/22	6/14	3	0.1	Stantec 2008a
2008	Rollins	ME	Lincoln	forest edge	40	53	4/23	6/13	166	3.1	Stantec 2008a
2008	Rollins	ME	Lincoln	forest edge	20	53	4/23	6/13	106	2.0	Stantec 2008a

Appendix C

Raptor Survey Results

Appendix C Table 1. Species composition of raptors observed during raptor surveys

Species	4/25	5/1	5/2	5/7	5/9	5/10	5/13	5/14	5/20	5/23	5/29	5/30	Entire Season
american kestrel			1		1								2
bald eagle								1					1
broad-winged hawk	2		1	1		1	2	1	1			2	11
osprey				1					1				2
red-tailed hawk			1	1	2		3				1		8
sharp-shinned hawk				2				1					3
turkey vulture	4	3	3	1	4	2	2	3		1	3	3	29
unknown buteo								1	1				2
Daily Totals	**6**	**3**	**6**	**6**	**7**	**3**	**7**	**7**	**3**	**1**	**4**	**5**	**58**
Hours of Observation	**7**	**7**	**7**	**7**	**7**	**7**	**7**	**7**	**7**	**2**	**7**	**7**	**79**
Daily Passage Rate	**0.86**	**0.43**	**0.86**	**0.86**	**1.00**	**0.43**	**1.00**	**1.00**	**0.43**	**0.50**	**0.57**	**0.71**	**0.73**

Appendix C Table 2. Observation totals of raptors by hour

Species	08:00-09:00	09:00-10:00	10:00-11:00	11:00-12:00	12:00-13:00	13:00-14:00	14:00-15:00	15:00-16:00	16:00-17:00	Grand Total
american kestrel	1							1		2
bald eagle						1				1
broad-winged hawk	4			3	1				3	11
osprey			1			1				2
red-tailed hawk					2	2	2	1	1	8
sharp-shinned hawk			1		2					3
turkey vulture	2	4	4	7	3	5	2	2		29
unknown buteo					1			1		2
Hourly Totals	7	4	6	10	9	9	4	5	4	58

Appendix C Table 3. Raptor flight altitudes by species

Species	120 m or greater	less than 120 m	Outside 1 km	Entire Season
american kestrel			2	2
bald eagle	1			1
broad-winged hawk	2	5	4	11
osprey		2		2
red-tailed hawk	6	2		8
sharp-shinned hawk		3		3
turkey vulture	2	25	2	29
unidentified buteo	1		1	2
Entire Season	**12**	**37**	**9**	**58**

Appendix C Table 4. Summary of Regional Spring 2008 Migration Surveys*

Location	Observation Hours	BV	TV	OS	BE	NH	SS	CH	NG	RS	BW	RT	RL	GE	AK	PG	ML	UA	UB	UE	UF	.UR	MK	TOTAL	Birds/ hr
Bradbury Mountain, Maine	118	0	0	71	28	24	337	1	1	1	534	8	1	0	49	2	42	1	0	0	0	4	0	1,104	9.35
Barre Falls, MA	20.5	0	3	10	2	0	14	1	0	0	46	4	0	0	8	0	0	0	0	0	0	2	0	90	4.39
Hawk Mountain, PA	67	3	0	22	14	6	15	5	0	3	25	16	0	0	2	0	2	4	2	2	0	18	0	139	2.07
Oakfield, ME	*79*	*0*	*29*	*2*	*1*	*0*	*3*	*0*	*0*	*0*	*11*	*8*	*0*	*0*	*2*	*0*	*0*	*0*	*1*	*1*	*0*	*2*	*0*	*58*	*1.12*

* Data obtained from hawkcount.org.

Abbreviation Key:

BV - Black Vulture
TV - Turkey Vulture
OS - Osprey
BE - Bald Eagle
NH - Northern Harrier
SS - Sharp-shinned Hawk
CH - Cooper's Hawk
NG - Northern Goshawk
RS - Red-shouldered Hawk
BW - Broad-winged Hawk
RT - Red-tailed Hawk
RL - Rough-legged Hawk

GE - Golden Eagle
AK - American Kestrel
ML - Merlin
PG - Peregrine Falcon
SW - Swainson's Hawk
UR - unidentified Raptor
UB - unidentified Buteo
UA - unidentified Accipiter
UF - unidentified Falcon
UE - unidentified Eagle
MK - Mississippi kite

Appendix C Table 5. Summary of other publicly available spring raptor survey results at other proposed wind facilities

Project site	Date	Survey Days	Obs. Hours	Habitat type	Number of Raptors	Number of Species Observed	Raptors/Obs. hour	Range in Daily Passage Rates	% below (reported turbine height)
Spring 2005									
Sheffield, Caledonia Cty, VT	April - May	10	60	Forested ridge	98	10	1.63	n/a	(125 m) 69%
Deerfield, Bennington Cty, VT (Existing facility)	April 9 - April 29	7	42	Forested ridge	44	11 (for both sites combined)	1.05	n/a	(125 m) 83% (at both sites combined)
Deerfield, Bennington Cty, VT (Western expansion)	April 9 - April 29	7	42	Forested ridge	38	11 (for both sites combined)	0.9	n/a	(125 m) 83% (at both sites combined)
Spring 2006									
Lempster, Sullivan Cty, NH	Spring 2006	10	78	Forested ridge	102	n/a	1.3	n/a	(125 m) 18%
Mars Hill, Aroostook Cty, ME	April 12 - May 18	10	60.25	Forested ridge	64	9	1.06	0-5.04	(120 m) 48%
Spring 2007									
Stetson Mountain, Washington Cty, ME	April 26 – May 4	9	58.75	Forested ridge	34	10	.6	n/a	(125 m) 65%
Spring 2008									
Rollins Mountain, Penobscot Cty, ME	Apr 3 to Jun 3	15	108	Forested ridge	122	12	1.1	n/a	(125 m) 76%